

INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

INTERNATIONAL REVIEW
OF THE SCIENCE
AND PRACTICE OF AGRICULTURE

MONTHLY BULLETIN
OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

YEAR VII - NUMBER 12
DECEMBER 1916



ROME
PRINTING OFFICE OF THE INSTITUTE
1916

In quoting articles, please mention this BULLETIN.

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The Bureau assumes no responsibility with regard to the opinions and the results of experience outlined in the Bulletin.

The Editor's notes are marked (Ed.).

FIRST PART
ORIGINAL ARTICLES

Olive-Growing and Production in Spain

by

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ANTIQUITY AND DISTRIBUTION OF OLIVE-GROWING.

The cultivation of the olive in Spain is contemporaneous with the earliest development of the arts of civilisation. The oil obtained in the districts near the coast appears to have been one of the first articles of commerce dealt with by the Phoenician and Carthaginian colonists. As the use of olive oil by the native population became general, the cultivation of the tree increased in all districts which offered favourable conditions and especially in Andalusia where olive-growing was first started and where it has since preserved its greatest importance. The high prices of the oil, due to the difficulties of transport, encouraged the planting of the tree in the interior of the country where it is now established as far as the southern slopes of the mountain ranges (Sierra de Gredos and Sierra de Guaderama) which cross the central plateau and form for this plant an impassable barrier.

The olive-growing districts in Spain do not form a continuous region limited by lines of latitude or by definite isotherms. As the result of the mountainous nature of the country the limits of the district are variable in these respects, and localities, which are specially well-wooded naturally, may be included even if situated at altitudes higher than the tree will usually tolerate.

Olives are grown in thirty-six of the forty-nine Spanish provinces; they are not grown in the following provinces: — Pontevédra, Léon, Zamora, Valladolid, Ségovia, Soria, Palencia, Oviedo, Burgos, Santander, Biscay, Guipuzcoa and the Canary Islands. As the area devoted to olive-growing in the provinces of Lugo and Orense is only 407 acres it is evident that the

olive-growing region is limited by the central mountain ranges already mentioned which cross the plateau from W. S. W. to E. N. E. and meet the Iberian Mountains in the N. E. Beyond the latter range the north-eastern olive-growing districts are found in the lower part of the basin of the River Ebro and include the whole of the provinces of Navarre and Alva. In the north-western provinces and on the plateau of Old Castille the olive is not grown but it is thoroughly established in the basins of the Tagus, the Guadiana, the Guadalquivir, the Ségura and the Ebro.

The soils on which the olive is grown vary greatly, as do the geological formations from which these soils are derived. Most of the soils are formed from the remains of Cretaceous and Jurassic strata, from the Silurian slates of the Iberian Mountains and central ranges, from the Triassic sands and sandstones, and from the conglomerates, sands, sandstones, and gypsum beds of the Miocene which occur in the province of Alcaría and on the low plain of Aragon and South Castille (La Mancha). These olive-growing soils are comparatively rare in the valleys; the hilltops and slopes are the situations in which they are characteristically found. It may briefly be stated that in such situations the soils which are formed either *in situ* or from transported and partially broken down materials of a pebbly and stony character, which lack spring-water and usually contain a large proportion of calcium carbonate are undoubtedly in a bad condition for the cultivation of cereals but are well adapted to the growth of trees of the type of the olive.

As the result of these geographical features the olive-growing districts are found at altitudes above that of the irrigation canals and at present only 177 300 acres of olive groves are irrigated that is about 4.7 per cent of the total area under olive trees.

The provinces in which the tree is grown comprise not less than a third of Spain, and in this wide-spread district it is natural that the growth and yield of the tree should vary considerably. The changes in the environment of the plant in this extensive and mountainous country are numerous and have given rise to the many varieties known in Spain.

The study of these varieties have been the object of many experimental trials; special mention should be made of the work carried out in Andalusia by M. ROJAS CLEMENT Y MARTINEZ ROBLES and of that of Dr. COLMEIRO who has lately collected eighty varieties of which pictures are to be seen in the nursery of the Botanical Garden Madrid.

CHIEF VARIETIES GROWN IN SPAIN.

O. europea pomiformis Clem. ("Olivo manzanillo").—The tree is well developed, the branches are long with plentiful shoots and the leaves are large. The fruit is symmetrical and almost spherical and of a light purple colour when ripe; it is largely used in tanning and gives an excellent oil. This variety is cultivated in almost all the olive-growing provinces on account of its excellent yield, in spite of the fact that the yield is irregular from one year to another (vecera) and that it requires to some extent special soil conditions.

O. e. Columella Clem. ("Carasqueño"). — The tree is small, the branches are few and the leaves narrow. The large fruits are almost spherical and are borne in clusters of three or four; the colour changes from red to dark purple when the fruit is ripe. This variety is only suitable for certain soils and is liable to the attacks of insects.

O. e. Ceraticarpa Cln. ("Cornezuelo"). — The tree is well developed; the fruit which is borne singly is curved and ripens somewhat late; the oil of good quality but limited in amount. This variety is very resistant both to cold and drought.

O. e. rostrata Clem. ("Picudo" or "Cornicabra"). — The tree is large and the branches are well developed; the leaves are elongated and the upper surface is dark grey in colour. The fruit, which is cylindrical, but tapers towards the end, has a curved tip and is larger than that of the preceding varieties. This variety is hardy and considered very fruitful in Aragon.

O. e. Banqueri. ("Lechin" or "Pichelin"). — The olives are small oval and somewhat curved; they are equally suitable for the manufacture of pickles (Olives de Cuquillo) and for the extraction of oil. The variety is hardy and yields a good crop.

O. e. Alba ("Salceño" or "Varal blanco"). — The tree is large with numerous branches and, as the lower surface of the leaves rather than the upper is exposed to view, it has a light aspect to which its name is due. The fruits, which are small are borne in clusters and enclose a relatively large kernel and pit.

O. e. racemosa ("Arbequin" or "Racimal"). — The tree is of medium size with drooping branches. The blackish fruits yield a large quantity of oil good in quality. The variety begins to bear fruit after a short period of growth but gives an irregular yield from year to year.

O. e. nigricans ("Empeltre"). — The tree is not large except in rich soils; the leaves are long and narrow; the fruit is round and yields a large amount of excellent oil. This variety begins to bear fruit as a comparatively young tree; it is hardy and is valued for these qualities in the province of Tortosa and in other districts of the Ebro.

O. e. maxima Clem. ("Morcal"). — The tree is large and the olives are big, oval, rounded at the base and flecked with white. The fruit is used both for the extraction of oil and for preservation in salt water (verdeol). The yield is low and the tree bears only at a comparatively late age.

O. e. viridula, Gouan. ("Verdal"). — This variety is a smaller tree than the preceding ones; the branches are long and the leaves small; it is also somewhat tender. The single fruits are large and oval and are preserved in salt water.

O. e. regalis ("Real sevillana"). — This variety is chiefly found in Andalusia; the leaves are large and elongated and the fruit, which is the largest of all the varieties of olives, is nearly round and blue black when ripe. This is almost exclusively a table fruit and its cultivation has been very lucrative in lower Andalusia.

O. e. argentata, Clem. ("Moradillo" or "Nevadillo blanco"). — The tree is large and the fruits are almost spherical and dark purple in colour.

The yield is plentiful and the oil is equally satisfactory in quantity and in quality.

O. e. soriana ("Nevadillo negro"). — The tree is of medium size the upper surface of the leaves is dark green and the lower a mother-of-pearl white. The fruit is similar to that of "Moradillo blanco" and of good quality.

O. e. hispidensis ("Gordal" or "Ocal"). — This olive-tree is large, and bears at an early age; the branches are strong and lustrous and the leaves are large. The fruit is almost as large as that of the Sevillano and the tip is pointed; it is greyish when ripe, forms a good table fruit and yields oil satisfactory in quality and quantity.

O. e. gienensis Colm. ("Javaluno"). — The tree is well-developed and bears large elongated olives.

O. e. ovata Clem. ("Tachuno castellano" or "Cirujal"). — The tree is of medium height; the branches are long and bear plentiful side shoots; the leaves are narrow and long. The small oval fruit ripens early and gives a very fine quality of oil.

Other less common varieties. — Among these may be mentioned "Colchonudo" "de Arola" "Tempranillo" "Rodonillo" "Bellotudo" "Permejuela" "Nogral" "Verdaleja" "Madrileño" "Ojo de liegre" which have been described by M. Colmeiro in his work, to which reference has already been made. There are other varieties in addition to these which might also be mentioned, but, as they have not been clearly classified, it is possible that they may prove to be merely local names for varieties which have been already described.

METHODS OF CULTIVATION.

Although the olive is grown extensively in Spain, its cultivation, in comparison with that of other important crops, has been little studied and cared for. During the last few years, however, a tendency to improve the methods of cultivation has been observed.

The plant is usually propagated by cuttings which are permanently planted. In the province of Valentia and in parts of Andalusia the cuttings are planted singly; in the majority of the provinces several cuttings are planted on the same spot, and these give rise to a number of shoots of which three or four are preserved, allowed to grow and trained in a definite manner. In the eastern provinces the practice of planting cuttings in nurseries is spreading.

As regards tillage the land is ploughed three or four times usually between the end of the winter and the summer. Care is taken that the direction in which the land is ploughed on each occasion crosses that direction in which the work was carried out on the preceding occasion. Tillage at the foot of the trees is carried out by hand and takes place at two seasons in the year. In the southern districts a ditch is dug round the trunk in the autumn to collect rain water and in the spring the soil round the trunk is thrown up to form a mound ("aporcando"). In other

stricts the process is reversed ; in the autumn a mound is thrown up and the tree as a protection against drought and in the spring the mound destroyed.

Manures are very little employed in olive-growing. Up to recent years only the olive-groves in the neighbourhood of towns received a little manure. Today superphosphate is used in Andalusia and in the province of Valencia while some more advanced agriculturists have begun to employ complete mineral manures.

As regards pruning there are no definite regulations. Ten or twelve years after the planting of the cutting the branches of the tree are first pruned but with great moderation ; only after twenty or twenty-five years are the trees thoroughly pruned at regular intervals. In the eastern provinces, in Aragon, Navarre, and Catalonia, pruning is carried out every ten or twenty years ; in Andalusia every three or four years ; in New Castille every five or six years. The number of branches suppressed is variable. In many parts of Andalusia, the pruning of the young shoots under the name of "tala" is very thorough and is followed in the next year by the removal of the superfluous older branches. Every thirty or forty years the trees are heavily trimmed and a new surface of wood exposed ; this process gives new vigour to the tree and is carried out successively on the different stocks of each olive grove.

The different practices observed in this work are probably due not merely to local custom, but partly to local variations in growth as the result of the diverse climatic conditions, and of the use of different varieties of the tree.

In the warmer regions the fruit is gathered in the autumn months ; in the other districts in the winter. As a rule gathering takes place later than is necessary to obtain a good quality in the fruit, but this mistake is being corrected in the chief centres of production.

In almost all Andalusia the fruit is knocked down with long poles and the practise is justified by the great height of the trees ; an exception is made for olives which are destined for table fruits. In the central districts hand-picking is known as "ordenó" - a word which is also employed for the milking of cows goats etc.

More than half the olive groves in Spain are cultivated without the presence of another crop. Where the nature of the soil is suitable, cereals, the vine, the almond and the hazel are grown with the olive. Cereals and the vine are the crops usually found in the olive groves ; but the almond is predominant in the east and the hazel in Catalonia.

DEVELOPMENT AND PRESENT CONDITION OF THE OLIVE PRODUCTION.

The modern development of olive growing in Spain has been very slow in comparison to the progress made in the cultivation of other crops such as the vine and the orange. "L'Annuario estadístico de España" for 1858 gives the area devoted to olive-growing as 2 080 226 acres.

The "Estadística de la riqueza territorial" published in 1879 shows that this area had decreased to 1 972 877 acres.

In the "Avance sobre la producción del Olivo" published by the "Junta Consultiva Agronómica" in 1888 the area under olive groves is given as 2 849 932 acres.

In 1897 the "Estadística del Servicio agronómico" gives the total area as 304 941 013 acres and in 1903 the publication of the same department shows that the area has increased to 3 293 258 acres.

According to the "Avance estadístico de la riqueza que en España representa la producción media anual del Olivo y otras cosechas" which has recently been published by the "Junta Consultiva Agronómica", the average area under olives for the period 1904 to 1912 was 3 400 070 acres.

Finally the "Estadística de las producciones vitícola y olivarera en el año 1915" published by the same body gives the area as 3 659 644 acres.

It can be seen from these figures, that the area under olive groves is increasing and has been doubled in 57 years. Of the thirteen agricultural districts into which Spain is divided Western Andalusia has the largest olive growing area with 1 229 578 acres, followed by Eastern Andalusia with 758 428. At present these two districts contain more than half the olive growing acreage in Spain.

The yield per acre varies very much from one year to another. A comparison of the average yields of various periods does not clearly conform to the law of variations which might be applied. The average production in the ten year period from 1891 to 1900 was 8 049 lbs. per acre, that of the following fifteen year period was 14 556 lbs. per acre; from 1906 to 1910 the average yield was 12 259 lbs. per acre, and from 1911 to 1915, 16 326 lbs. per acre.

The value of the olive production has gradually increased. The figures given in the "Avance estadístico de la Junta Consultiva Agronómica" which summarises the financial returns of the period 1903-1910 are the following:

	£
Average value of the oil	9 523 932
Average value of the green olives	305 361
Average value of the leaves used as fodder	492 210
Average value of the wood as fuel	323 907
Average value of the residues of the fruit	665 163
Average value of the oil for tanning	206 126

In the south and east of Spain the cultivation of the olive is being developed and is very prosperous; but in these districts large areas are found, suitable for new plantations, which are still uncultivated.

The economic returns from the areas in cultivation could be improved by the expenditure of increased capital and care in the planting, maintaining, manuring of the groves. Such expenditure, as experience has clearly shown will be amply repaid by the tree.

The most urgent needs of the olive industry are a scientific study of all varieties in regard to the nature of the fruit and oil and to the conditions which affect the growth of the tree ; a similar study of the methods of propagation with special attention to the effects of the various forms of grafting ; and a general and determined effort to cope with the numerous parasites and pests to which the tree is liable. These important tasks should engage the attention of the State, and of the societies of olive planters.

To the sphere of political economy should be assigned those measures needed to protect the pure olive oil against the competition of inferior foreign oils, and against adulteration and blending to which the decrease in exports to foreign markets are largely due.

These measures are of importance to all countries in which olive-growing is a fundamental industry.

SECOND PART. ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

**DEVELOPMENT
OF
AGRICULTURE
IN DIFFERENT
COUNTRIES**

1253 - Agriculture and its Allied Industries in Rumania. — XENOPOL N., in *Le Mouvement Economique*, Vol. XXIII, No. 136, pp. 125-154; No. 138, pp. 191-209. Bucharest, April 1 and June 1, 1916.

Since the Treaty of Adrianople in 1829, the production of cereals has become the most important feature in Rumanian agriculture. Up to that time Rumania's chief exports consisted of animal products *i.e.* cattle, wool, wax, wine, salt, hides and salt fish. But after 1829, when she obtained a new outlet for trade via the Black Sea, the character of her agriculture began to change and arable farming gradually displaced the old stock raising industry.

At the present day wheat is the chief crop and occupies an area of 5 million acres. The grain produced is of the finest quality, but the yield is very low (12 to 20 bushels per acre during the past 10 years) and might well be increased 50 per cent by improved methods of cultivation, including the use of artificial manures, and by a better utilization of the available water supplies. Exports of wheat during the years 1911 to 1913 were valued from £8 000 000 to £10 000 000 per annum and amounted to one half of the total exports of cereals. The Rumanian people eat very little wheat; out of a total population of 8 millions only about 2 millions consume it regularly, the staple food of the people being maize.

According to the official returns the gross value of the Rumanian crops in 1914 was as follows:

	£
Cereals	40 078 000
Pulse and root crops	2 768 000
Fodder crops	3 688 000
Market-garden crops	979 000
Oil seeds	618 000
Other crops (fibres etc.)	533 000
Total	48 664 000

There is a disproportionate amount of cereals grown in the country and it is questionable whether it be good policy to allow the cultivation of wheat and maize to replace grass to such a large extent. The vast area under wheat is no doubt a direct response to the good prices obtained on foreign markets, but the same cannot be said of maize which fetches a much lower price, and its continued growth on a big scale must be attributed in a great measure to the traditional habits of the Rumanian peasants.

The distribution of the area amongst the different sized holdings is given in the adjoining Table. Nearly half the land is in the hands of peasant proprietors and of the other half, four fifths consist of large holdings and estates, while medium-sized farms only occupy 10 per cent of the total area. The peasants, besides owning half the agricultural soil in the country also hold a great part of the estates, paying rent either in cash or in kind. But the disadvantages of this system of land tenure are evident in the low standard of cultivation and the absence of proper buildings, which prove that the land is being worked with insufficient capital.

Distribution of area amongst the different sized holdings.

Size of holding	No. of holdings	No. of holdings per cent of total no.	Area occupied	Area occupied per cent of total area
acres			acres	
under 1 1/4	62 832	6.60	65 000	0.34
1 1/4 to 2 1/2	81 039	8.50	180 000	0.93
2 1/2 " 5	147 900	15.20	586 000	3.01
5 " 7 1/2	131 630	13.60	834 000	4.30
7 1/2 " 10	172 446	17.90	1 564 000	8.08
10 " 12 1/2	148 717	15.40	1 759 000	9.08
12 1/2 " 17 1/2	131 145	13.50	1 840 000	9.50
17 1/2 " 25	45 230	4.70	975 000	5.05
Total under 25 acres . . .	920 939	95.40	7 803 000	40.29
25 to 125	36 318	3.70	1 722 000	8.89
125 " 250	2 405	0.26	413 000	2.13
250 " 1 250	3 314	0.41	2 020 000	10.43
250 " 2 500	1 122	0.13	1 987 000	10.26
500 " 7 500	771	0.09	3 060 000	15.80
500 " 12 500	112	0.01	1 077 000	5.55
Above 12 500	66	0.00	1 287 000	6.65
Grand total . . .	965 047	100.00	19 469 000	100.00

Very little land is held by foreigners in Rumania. Article 7 (§ 5) of the Constitution (revised on October 13, 1879) lays down that "only Ru-

manians born or naturalised, may acquire rural property in Rumania. This did not interfere with foreign owners who were already in possession in 1879, but such owners are no longer numerous for many sold out the properties as the price of land rose.

While exports of cereals have been increasing, those of animal products have decreased from about £2 000 000's worth in 1879 to £116 000 worth in 1913. All Rumanian exports are of an extremely bulky nature while the imports consist of expensive products which occupy little space. Also, many raw materials such as hides and wool are exported and then reimported again as manufactured articles. Both these facts point to the necessity of establishing national industries.

So far nothing has been done with regard to the regulation of water systems, and it is only within the last few years that a proper scheme of river management has been in force. Improved means of transport are badly required for there are only 2200 miles railways on an area of 89 000 square miles. With regard to the important question of the storage of cereals, while the building of the docks at Braila and Galatz has furnished the necessary accommodation for all corn awaiting shipment, the rest of the country is still unprovided with warehouses. These should be established by the Government at all the principal railway stations for the purpose of collecting and grading cereals. By this means a farmer would then be able to raise cash on his harvest while awaiting the best opportunity for marketing his corn.

The condition of the peasants is still unsatisfactory in many parts of Rumania though measures of reform have already been taken, e.g., establishment of rural banks, State aid for the purchase of land, foundation of peasant societies. An agrarian law passed in 1908 regulates certain agricultural payments: a minimum wage was fixed for labour and a maximum price for rent. Communal fields have been established where the cultivation of fodder crops will be given every encouragement. Proposals have also been made with regard to the compulsory break up of large estates for the purpose of increasing the number of small holders.

Turning to the agricultural industries: A capital of £1 640 000 was invested in flour mills with a plant of 22 120 HP, yet the exports of flour only amount to 7 per cent of the corn. The manufacture of woollen materials is carried out in 13 factories (3 162 HP), which only deal with the coarser kinds of wool and are nothing like sufficient to meet the requirements of the country. Finer qualities of goods are imported in large quantities. The industry could well be expanded if the home production of wool were more abundant and of better quality. But for some time past the number of sheep in the country has been diminishing and little is being done to improve the fineness of the wool. At the model farm at Laza, it is true, some experimental crosses were carried out between the native breeds Tzigae and Frise; and the Ministry of Agriculture imported some Merinos to the Royal estates, and crossed them with local sheep with excellent results so far as the wool was concerned. These, however, are only isolated trials and have no effect on the sheep of the country whose flocks

still remains of a very poor quality. The hemp and linen industries are of little importance and only represent an invested capital of £81 000; the greater part of the hemp produced is exported. The sugar industry which dates back as far as 1873 is somewhat on the decline as the farmers have given up growing sugar beets in favour of more paying and less troublesome crops. The present area under beets is about 35 000 acres and the yearly production of sugar varied from 200 000 to 300 000 tons in 1909 to 1913.

Of the Rumanian forests, which cover 20 per cent of the total area of the country, the State owns some 2 600 000 acres while 4 000 000 acres are private property. The forest industries are in the hands of 14 big companies from whose books the following data have been summarised to give some idea of the total vested interests engaged.

	£
Ordinary shares	2 626 000
Debentures	639 000
Working capital (1913 balance sheet)	8 112 000
Buildings and plant	1 555 000
Reserve funds	81 000
Sinking funds	717 000
Net profits (1913 balance sheet)	272 000
Return on capital	1.8 to 33 per cent
	(2 companies show a loss)

A few forest societies have been formed among the peasants, but as they are working without much capital their output is still low. The lack of roads and railways makes the forests very inaccessible and the preparation of transport routes is a heavy initial expense for small associations. Charters have also been granted to two foreign companies (with capitals of £111 000 and £880 000) for the working of Rumanian forests.

There are in all 71 saw mills in the country which employ 12 000 men. Another 50 000 men are occupied with felling the trees and transporting them to the mills. A large proportion of the timber (valued at £940 000 in 1913) is exported, but at the same time Rumanian imports of wood and wood products amount to £620 000 per annum of which the greater part consist of manufactured articles. The paper-making industry is important and represents an invested capital of £1 020 000. It deals annually with £103 000 worth of raw material of which about one third is imported, and produces paper and cardboard which amounted to 18 200 tons in 1914 and was valued at £432 000. No paper is exported, but 3 600 tons of pulp (valued at £32 000) went abroad in 1913.

1254 - Testing, Storage and Preparation of Unpolished Rice (bras pitjah koelit). — OTTOW W. M., in *Natuurkundig Tydschrift voor Nederlandsch-Indië*, Part LXXIV, pp. 143-196. Batavia, 1916.

In connection with the importation of unpolished rice for preventing and restricting beri-beri in the Dutch Indian Army questions arose as to the testing, the storage and the treatment of the above named form of rice,

which have led to the writer's investigations. The results of the investigations are summarised by the writer as follows:

1. — On the ground of taste, no reasonable and still less insurmountable objections can be made to the use of unpolished rice which offers sufficient protection against beri-beri.

2. — Compared with finished rice, unpolished rice becomes easily and speedily unfit for consumption, by decay, by damages done by insects, etc. Although periodical exposure to diffused daylight and regular turning over of the stock have a favourable influence with regard to deterioration during storage, still unpolished rice can scarcely be kept for longer than two months without even quite perceptible alterations.

3. — The necessity of preserving unpolished rice, which must be kept for some time, is best practically met by the use of chloroform or carbon tetrachloride. These are applied in the form of vapour, for which comparatively small quantities are sufficient. They do not modify the hardness, the smell or the taste of the rice, and they exercise a favourable influence on the preservation of the desired activity.

4. — The $P_2 O_5$ proof with the fixed amount 0.4 % of this substance is not sufficiently to be relied upon when testing rice as to its value as protective against beri-beri.

5. — A new method of chemical investigation better enables us to judge of this value. This method consists in the estimation of the spint dry-residue, according to a process which has been fully described in the text. As criterion the dry-residue limit was to be fixed between 0.55 and 0.6 %.

6. — The physiological test with the help of test-animals is at present the only one which leads to a never-failing, always correct judgment.

The evident suitability of rice-birds for this purpose has led to a method of investigation which in every respect deserves recommendation.

7. — It appears more and more distinctly that requirements for an adequate activity of rice are completely worthless, if at the same time certain stipulations are not made as to the treatment of the rice, viz. the washing and steaming, processes to which the rice must be subjected before it is ready for consumption.

A specimen has been found with a $P_2 O_5$ amount lower than the standard norma of 0.4 %, and which notwithstanding this was sufficiently active.

This example shows that there are kinds of unpolished rice to be obtained which in appearance and taste differ little, if anything from entirely polished rice, and which still give more than sufficient protection against beri-beri.

AGRICULTURAL EDUCATION 1255 - *Agricultural Instruction by Correspondence in France.* — LINDET, in *Comptes Rendus de l'Académie d'Agriculture de France*, Vol. II, No. 32, pp. 931-993, Paris, 1916.

In October 1913, the Union of Agricultural Syndicates in the south-east of France began a course of agricultural instruction by correspondence. During its first year as many as 207 pupils were registered, but with the out-

ak of war those left on the land were deprived of all leisure, and the number of pupils fell to 54 in 1914-1915 and to 34 in 1915-1916.

At the beginning of each month from October to April every member of the course receives instructions for work, in the carrying out of which he is encouraged to get what help he can from his parents or from a local "monitor" appointed by the Union. The work includes:

- 1) A course of reading for which books are provided in local libraries or obtainable from the Union at a very low cost.
- 2) The setting up of a small experimental ground where each pupil tests for himself the effect of manurial dressings, of early or late sowing, etc.
- 3) The carrying out of simple experiments such as the germination of seeds, the relationship between the density of potatoes and their starch content, the flocculation of clay by lime, the effect of sodium nitrate on clover and straw production, the topping of sugar beets, the washing of roots, etc.
- 4) Excursions organised by the monitor to neighbouring farms where pupils are expected to take notes on the crops, on the live stock, on the soil elements, etc.
- 5) The writing of papers in answer to questions on such subjects as the nature of the local soils, the crops of the districts and their industrial uses, the treatment of seed, the planting of fruit trees, etc. This branch of work involves personal effort on the part of the pupil who will have to consult his books in order to find an answer to the questions.
- 6) The working out of sums on: the price of wheat per given volume and its density and price per quintal (220 lbs); the value of a manure heap, its composition and the value of each constituent; the price of rams for maintenance or fattening; etc.

Every month the pupils send in their work which must include a report of their excursions and of the progress of their experiments. The papers are corrected and returned, the names of the pupils getting the highest number of marks being published in the monthly sheet of instructions together with remarks of a general nature which apply to all members of the course. When specially good papers are sent in these may even be reproduced in the monthly sheet.

CROPS AND CULTIVATION.

- A Detailed Study of Effects of Climate on Important Properties of Soils. — IRMAN C. B., and WAYNICK D. D., (Laboratory of Soil Chemistry and Bacteriology, University of California) in *Soil Science*, Vol. I, No. 1, pp. 5-48. New Brunswick, N. J., 1916. In 1908 a set of experiments were started under the joint auspices of U. S. Department of Agriculture and the Agricultural Experiment Stations of Kansas and California. Two soil blocks, 5 ft. square and 3 ft. deep were moved from each station to the other two stations and placed in position as nearly as possible in the original soil layers. A similar block

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AND
MICROBIOLOGY

of soil was dug up and replaced in its position at every station and a ch plot of undisturbed soil was also set aside. It was therefore possible compare at each station 1) the natural undisturbed field soil; 2) the nat field soil after having been disturbed; 3) the soils from the other two periment stations. When 7 years later the present writer attacked the F blem of the effects of climate on soils, the above plots appeared to prov admirable material for study in this connection, and it was decided subject them to a physical, chemical and bacteriological investigation.

The most striking change undergone by the transported soils is their appearance. SHAW and WALTERS originally described the C. formian soil as "Sacramento silt loam", the Kansas soil as a "dark hea loam" and the Maryland soil as a "Light yellow clay". During the per which has elapsed since the soils were moved, their colour has chang markedly, Kansas and Maryland soils in California becoming of a mu deeper reddish colour, and Kansas and Californian soils bleaching to light or yellowish clay in Maryland. Soils brought to California have a increased their hygroscopic coefficient, their moisture equivalent (1) a their wilting point.

The bacterial investigations show that in general the numbers bacteria increase when arid soils are put under more humid conditio and decrease when humid soils are brought to a drier climate. Ammon fication and nitrogen fixation vary in a similar fashion and so does nit fication with certain forms of nitrogen. The destruction of cellulose, on t other hand, varies inversely with the bacterial numbers.

Chemical analyses reveal marked changes in the acid soluble co stituents of soils due to climatic effects. For example the Californian s increases in lime in Kansas and Maryland (particularly at the latt station) and loses in iron. Though difficult to generalise, the tenden is for soils to increase in iron and decrease in alumina when placed und arid conditions and *viceversa*. Phenomenal losses in certain constituent seem to have occurred in some soils even when the latter were not move the Maryland soil losing enormous quantities of magnesia in the give period. With regard to the total water soluble constituents, these d crease considerably when the Californian soil is moved to Kansas Maryland and the same occurs with Maryland soil when moved to Kan or California.

Some of the effects noted are difficult to explain in the light of a present knowledge, but the causes of other effects stand out quite clear. For example, it appears that the total internal surface of soils per un of dry weight increases with the degree of aridity of the climate, and th exercises an important influence on the hygroscopicity, moisture equ valent, wilting point, tenacity, absorbing power and many other phy cal characteristics of a given soil. With the chemical data the causes f the changes are more difficult to define because of the great irregulari of some of the results obtained. But they indicate clearly that profou

(1) See R. Oct. 1916, No. 1059.

changes take place in the chemical constitution of a soil when it is moved from an arid to a humid climate or *vice versa*. In general, bacterial activities are far more pronounced under humid than under arid conditions except with regard to cellulose decomposition. This is probably due to the increase in the carbon of soils under arid conditions and to the decrease in the water soluble substances.

37 - **The Relationship between the Osmotic Pressure of the Soil Solution and the Growth of Wheat.** — Тулайков М. Н. (Тoulaikow M. N.) in *Журнал Опытной Агрономии имени П. С. Коссовича* (*Review of Agricultural Experiments dedicated to the memory of P. S. Kossowitch*). Vol. XVII, No. 2, pp. 122-163. Petrograd, 1916.

In order to determine the correlation between the salt content of the soil and the growth of plants, a series of experiments were undertaken at the Station of Besentchaouk where the alkali soils of the Province of Samara are under special investigation. The osmotic pressure of the soil solution was artificially raised by the addition of mineral salts to the soil and was studied in its relationship to the growth of Bielotourka wheat, a hard spring variety which is widely distributed in the region.

The experiments were begun in 1910 and a first report has already been published (1). Plants were grown in zinc cylinders each of which contained 5 kgs. of black soil (Tchernozem) and about 50 gms. of a mixture of nutrient salts. Before being filled into the pots the soil was dried in the sun till its moisture content had been reduced to 10 to 11 per cent. The nutrient salts were added in the form of solution, but the salts used to raise the osmotic pressure of the soil solution (*i. e.* sodium chloride, nitrate and sulphate; ammonium chloride and sulphate; calcium chloride) were applied in the solid form and in three different ways;

- 1) The whole amount was mixed with the soil at the start so that soil solution was immediately brought up to the required osmotic pressure.
- 2) The salts were added at the rate of one sixth of the total amount week for 6 weeks. By this means it was possible to reproduce the natural conditions prevailing in alkali soils where the osmotic pressure of the solution increases as the growing season advances owing to the decrease of water content in the soil. By spreading the applications over 6 weeks, the plants had received the whole amount before flowering.
- 3) The whole amount was added in a single dressing at the time of flowering.

Distilled water was used for bringing the moisture content of the soil to 60 per cent of its maximum water holding capacity or in other words 24 per cent of the dry soil. Selected seeds or pure lines of Bielotourka wheat were employed and careful records were kept of the dates of sowing, germination, tillering, shooting, flowering, and ripening. The height of the plants was also measured at different times. When the plants were harvested, the dried grain and straw were weighed separately and the grain was analysed for total and protein nitrogen and for moisture; the

(1) See R. 1911, No. 987.

weight of 1000 seeds was also determined and their appearance was not (steeliness or starchiness) (1).

The results of the experiments showed that the osmotic pressure of the soil solution had a marked influence on plant life. This influence was already appreciable when the seeds were germinating and could be followed throughout the development of the plant.

As the osmotic pressure increased, germination was retarded and the seedling became less vigorous while the shooting of the corn and flowers were earlier, so that the whole period of vegetation was considerably shortened. An osmotic pressure of 7 atmospheres obtained by the addition of sodium chloride shortened the life of plants by 7 days in 1915 and by 10 days in 1914. The same pressure exerted by sodium sulphate only reduced the period by 4 days and the effect of nitrates was still less powerful, their solutions having no appreciable effect except at higher pressures altogether.

With regard to the development of the plant and the yields of straw and grain, it was found that there existed a definite optimum osmotic pressure for each of the salts tried. The point varied between 1 and 3 atmospheres according to the different salts and was marked by maximum crop yield and by a low ratio of straw to grain. As the osmotic pressure increased above this optimum point, harmful effects became evident, the development of the plant was suddenly checked and low yields of grain and straw were obtained. A rise in the osmotic pressure of the soil solution caused the addition of all salts except nitrates lowered the ratio of straw to grain.

It was established in the earlier experiments that when the osmotic pressure of the soil solution is between 3 and 5 atmospheres, plants are able to make the available water go further than under normal conditions. This conclusion was fully confirmed by the experiments of 1914 and 1915. In Table I are given the mean coefficients of transpiration obtained with the normal soil solution and with solutions whose osmotic pressures varied from 1 to 5 atmospheres. The figures show that in general transpiration decreased as the osmotic pressure increased up to 5 atmospheres. Above that limit a further increase in the osmotic pressure resulted in a coefficient of transpiration higher than that for the normal soil solution. Magnesium chloride did not follow this rule. The fact that Bielotourka wheat uses less water per unit of dry matter produced when the osmotic pressure of the soil solution rises above normal, is of the greatest importance in arid regions where the climatic conditions are similar to those at the Besenchouk station.

With the soil solution at its optimum osmotic pressure the wheat not only gave maximum yields, but both straw and grain contained maximum amounts of total and protein nitrogen. In other words, the plant was making the best possible use of the nutrient substances at its disposal to produce the largest amount of grain of the best quality. Table II summarises the results obtained in this connection.

(1) See *ibid.* Sep. 1916, No. 964.

TABLE I. -- *Effect of the osmotic pressure of the soil solution on the coefficient of transpiration of wheat plants (average of the two years 1914 and 1915).*

Salts used	Normal soil solution	Coefficients of transpiration			
		Abnormal soil solutions, osmotic pressure			
		1	2	1	1
Sodium chloride	365.6	359.5	346.6	362.8	358.4
" sulphate	—	364.3	—	342.6	349.4
" nitrate	—	352.0	335.7	317.9	382.8
Ammonium chloride	—	329.9	323.1	295.2	364.2
" sulphate	—	331.4	308.3	294.7	300.1
" nitrate	—	336.0	304.6	292.6	—
Magnesium chloride	—	350.4	358.8	328.7	413.8
" sulphate	—	366.9	360.0	343.4	359.2
Calcium chloride	—	347.7	329.6	341.8	—
Mean for all salts	365.6	348.6	333.3	329.9	314.8

TABLE II. -- *Effect of the osmotic pressure of the soil solution on the yield and nitrogen content of wheat (average of the two years 1914 and 1915).*

	Nitrogen of grain				Nitrogen content of grain (per cent)				Total amount of nitrogen per pot			
	= 100				= 1				= 100			
Control (normal soil solution)												
Osmotic pressure of soil solution in atmospheres	1	2	3	5	1	2	3	5	1	2	3	5
Salts grouped by their bases:												
Sodium salts	112	99	89	57	1.12	1.29	1.41	1.58	125.4	127.7	125.5	90.1
Ammonium "	122	139	121	—	1.33	1.55	1.67	—	162.3	215.4	202.1	—
Magnesium "	96	94	82	62	1.11	1.10	1.22	1.37	106.6	103.4	106.1	87.7
Salts grouped by their acid radicals:												
Chlorides	109	108	86	52	1.16	1.27	1.43	1.68	126.4	137.2	123.0	69.6
Sulphates	108	111	118	98	1.14	1.24	1.32	1.51	123.1	137.6	155.8	148.0
Nitrates	118	120	97	—	1.30	1.62	1.73	—	160.4	194.4	167.8	—
Mean for all salts	110	110	100	65	1.18	1.33	1.43	1.68	129.8	146.3	143.0	109.2

Conclusions. — In pot cultures it is possible to regulate the osmotic pressure of the soil solution by the addition of soluble salts (nutrient and otherwise) to the soil and thereby not only to increase the yields of grain and straw above the normal, but also to raise their nitrogen content. The study of the osmotic pressure of the soil solution is of special interest in relation to steppe and alkali soils where it is exceptionally high and in the case of peat soils and bogs where it is exceptionally low. It may also throw light on the action of "indirect" manures, such as for instance that of sodium chloride which is frequently used on sugar beets. Hitherto its beneficial effect has been looked upon as due to a liberation of potash in the soil, instead of which it might be caused by a simple increase in the osmotic pressure.

It is recommended that the investigations be extended to other farm crops and the effect of the soil conditions determined not only on the nitrogen content of the plant but also on its other constituents, fats, sugar and starch.

1258 — **Investigations on the Microorganisms of Peat Soils, Waste and Cultivated.** — ARND T., in *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten* Vol. 45, Nos. 8-25, pp. 554-574. Jena, June 19, 1916.

At the Bremen Station for peat investigations ("Moorversuchsstation") a series of experiments were undertaken to determine the changes, if any, in the bacterial activity of peat soils brought about by drainage, liming and tillage. Only preliminary trials have as yet been accomplished, but these have already shown that there exists a striking difference in bacterial activity between waste and cultivated land. Soil samples were taken from twelve different parts of the experimental ground and were tested for: ammonification, nitrification, denitrification, the decomposition of cellulose, the presence of *Azotobacter* and the fermentation of mannite. The results may be summarised as follows:

1) Ammonifying organisms were found in all samples, even in the most strongly acid subsoils from waste land. They were far more active in surface soil than in the underlying layers, the actual numbers in the subsoil being very small and their vitality reduced. Ammonia production also occurred much more freely with samples from soils which had been tiller manured or limed than with samples from land of the same type which lay waste. An application of dung to a peat soil which had a very low bacterial content resulted in a considerable and lasting increase in the numbers and activity of the putrifying organisms. The breaking up of waste land only affected the bacterial life in the top 8 in. of soil; sample of subsoil (8 to 16 in. deep.) showed about the same ammonifying power whether taken from waste or cultivated land.

2) None of the samples from waste land contained any active nitrifying organisms, neither did samples from cultivated land which were either unlimed or had only received lime at the rate of half a ton of lime per acre. On the other hand soil which had received one ton of lime per acre exhibited a marked power of nitrification, but it would seem that an even heavier dressing would be required in order to obtain an active develop

ment of the nitrifying organisms in the peat itself. Not a single subsoil examined, whether obtained from waste or cultivated land, contained any organisms capable of producing nitrites or nitrates.

3) Every sample tested was able to reduce nitrates, the surface soil of waste land being hardly more active in this respect than its subsoil. Where the land was cultivated, however, the reduction of nitrate took place much more readily with the surface than with the subsoil, and the same was true of cultivated surface soils as compared with the surface soil of waste land, more especially where tillage had been accompanied by liming. No differences were obtained in the denitrifying power of the various subsoils.

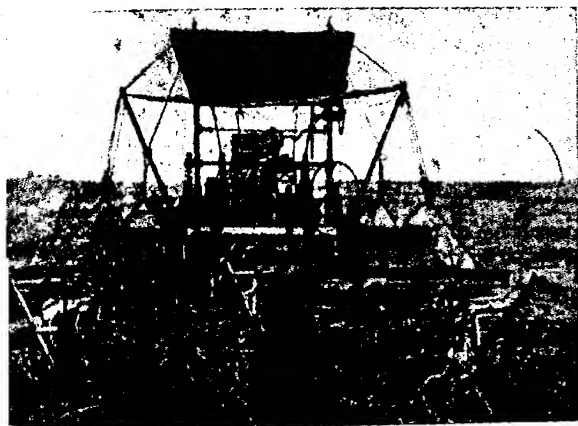
4) All surface soils exhibited a greater power for decomposing cellulose than their corresponding subsoils, the difference being very small in the case of waste land and much larger for cultivated land. Cultivated, limed or manured surface soil was also much more active than waste surface soil. As with ammonification and nitrification, maximum decomposition of cellulose occurred when the soil had previously received a dressing of dung.

5) In no sample was *Azotobacter* present. Surface soils and cultivated soils fermented mannite more readily than subsoils and waste soils, the maximum effect being again obtained with the dunged plot.

3259 - Reclaiming the Everglades of Florida. — WILLEY A. W., in *Scientific American*, Vol. CXX, No. 12, pp. 258-259. New-York, September 16, 1916.

In the south of Florida there are some 4 million acres of swamp known as the "Everglades" which are being converted into agricultural land by drainage. An accurate topographical survey of the district had shown that

OPENING UP
LAND FOR
CULTIVATION



Machine used for digging trenches and pulverising the soil.

the swampy condition of the area was due to the Okeechobee lake and that as the rim of the lake was some 20 ft. above the level of the tidal river, the reclamation could be effected by merely cutting canals through the rim of the lake and allowing the water to flow away by force of gravity. The first reclamation project which has already been carried into effect included the excavation of 4 canals of a total length of 200 miles and of an average cross section of 5×60 ft.; 6 dredges were employed for the purpose. For the making of the smaller ditches other machines were used. One of these is illustrated in the adjoining fig.; it not only dug trenches but pulverised the soil at the same time, moving across the land at the rate of 30 ft. in 10 hours. Another ditcher used was capable of cutting a trench 400 ft. long 6 ft. deep and 3 ft. wide in one day. The total length of the later canals amounted to 2000 miles, draining an area of $1 \frac{1}{2}$ million acres.

The success of the enterprise has been so complete that a second project is now in hand for reclaiming the remaining $2 \frac{1}{2}$ million acres and will be completed within a year. As soon as the land is ready it is sold by the State Government and divided up into farms, settlers being attracted from all the other parts of the United States.

The total cost of reclamation has been estimated at $4 \frac{1}{2}$ million dollars.

METHODS
OF SOIL
CULTIVATION

1260 - Experiments in the Application of Electricity to Plant Production, in England. INGVAR JORGENSEN, in *The Journal of the Board of Agriculture*, Vol. XXIII, No. 7, pp. 667-672. London, October 1916.

Experiments on the effect of overhead electrical discharges on crops were continued in 1915, a crop of oats being grown under this treatment at Lincluden Mains, Dumfries.

The crop was grown on ground which had been used for the same purpose in previous years for similar experiments with potatoes. The experimental ground consisted of two plots each of $1 \frac{1}{2}$ acres lying side by side, one of them receiving the electric discharge, the other being used as the control. The two plots were separated by a well-earthed wire screen reaching a height three feet above the level of the charged network. It was hoped by this means to prevent any considerable leakage of current from the electrified area to the control. Readings of a sensitive electrometer show that the screen much reduced the amount of discharge reaching the non-electrified area, but it did not do away altogether with the leakage.

The season was a particularly dry one, accompanied by a scorching sun, and as the soil is of a very porous nature the conditions were not conducive to a heavy crop.

From the early stages of growth the crop on the electrified area showed a marked superiority in comparison with that on the control area and did not suffer from the prevailing drought to the same extent.

The discharge was run for 557 hours during 108 days, i. e., an average of 5 hours a day.

The two crops when ready for harvesting were cut, threshed and weighed separately. The weights of the two crops are given below, and

show that the electrified crop, as compared with the non-electrified, showed the remarkable increase of 30 per cent in grain and 58 per cent in straw.

	Total grain.	Total straw.	Increase of grain.	Increase of straw.
Electrified	1 309 lb.	2 476 lb.	30 per cent.	30 per cent.
Control	1 008 lb.	1 572 lb.	—	—

An analysis of the grain and straw from the two crops was undertaken at the University of Leeds. The figures obtained for the experimental and control crops showed practically no difference apart from those accounted for by experimental error. Feeding experiments are needed before it can be concluded with certainty that the discharge has been without effect on the food value of the oats, but it is extremely unlikely that any difference would be demonstrated between the two crops.

1261 - **The Industrial Uses of Seaweed, More Especially as Manure.** — GLOESS P., in *Moniteur Scientifique du Docteur Quesneville*, Vol. VI, Part I, No. 893, pp. 97-108; Part II, Nos. 896 and 898, pp. 169-177 and 217-223. Paris, May, August and October 1916.

MANURES
AND MANURIN

The industrial uses of seaweed are classified as follows:

- I. The general use of seaweed more particularly for manure.
- II. The use of plants other than algae, especially grass wrack (*Zostera* spp.) as a source of:
 - a) fibre
 - b) paper
 - c) cellulose
 - d) potash manure obtained as a bye-product.
- III. The use of red algae (Rhodophyceae) for the production of gelose.
- IV. The use of the brown algae (Phacophyceae) especially the Laminariaceae (kelp) which contain no gelose,
 - a) as a source of algin for the production of:
 - i) waterproofing, dressing and gum substances;
 - ii) food substances;
 - iii) a natural algin product containing iodine;
 - iv) sodium peralginat, a bleaching agent;
 - v) various other materials for industrial purposes.
 - b) as a source of potash salts;
 - c) as a source of other salts;
 - d) as a source of iodine and bromine.

The use of seaweed as manure. — On the coasts of France (Brittany), England, Scotland, Ireland and in the Channel Islands two classes of seaweed are gathered: 1) the kinds that grow between tide marks (*Zostera* spp., red algae and *Fucus* spp.); 2) the drift weed which is washed up from below low-water mark (*Laminaria* spp., *Zostera* spp.). In the districts where it is collected it forms one of the principal manures and enables the land which is naturally poor to become productive.

On the Pacific Coast of the United States large quantities of kelp are harvested annually (1). The writer points out that a certain amount of waste is incurred by not recovering the iodine and bromine contained in the kelp. These elements being more valuable for chemical or pharmaceutical uses than for agriculture, their extraction would seem advisable especially as their recovery would enable the manure to be sold at a lower price.

The extraction of potash salts from seaweed. — The seaweeds used for this purpose consist of *Macrocystis* spp., *Nereocystis* spp. and *Pelagophycus* spp. which form the "giant kelp" of the American Pacific coast, and *Laminaria flexicaulis*, *L. Cloustoni*, *L. saccharina*, *Saccorhiza bulbosa* which are found in Europe. The average chemical composition of fresh European seaweed is as follows:

Water . . .	85 %				
		Mineral matter 7 %			
Dry matter . .	15 %		Potash salts . .	4 %	{ Chlorides . . 3.85 % { Iodide . . . 0.13 % { Bromide . . . 0.02 %
		Organic matter 7 %			
			Other salts . .	3 %	{ Chlorides, sulphate { phosphates of sodium { magnesium, calcium { iron, manganese.

Every year about 100 000 tons of fresh seaweed are gathered in France and 250 000 tons in the United Kingdom and Norway. From the 350 000 tons the following products are obtained: 175 tons of iodine, 7000 tons of potash salts, 15 000 tons of soda ash. By improved methods of manufacture the yield of iodine and potash salts might well be doubled and at the same time 10 000 tons of mineral salts other than potash, 175 tons of bromine and 28 000 tons of raw algin could be produced. With the use of cutters the seaweed harvest could also be increased.

The potash salts, which consist chiefly of the chloride, make up about 4 per cent of the fresh seaweed or 25 per cent of the dry matter. They are extracted by lixiviating the kelp, or may be obtained as an efflorescence on drying the seaweed by heat. The latter process yields a substance containing 65 per cent of potassium chloride (41 per cent of K_2O) which may be used as such for manure or subjected to purification as in the case of Stassfurt salts.

Other salts extracted by lixiviation. — These make up 43 per cent of the total salts, 3 per cent of the fresh seaweed or 20 per cent of the dry matter. They consist of about 50 per cent of sodium chloride, and 50 per cent of the other salts, and though much less valuable as fertilisers than the potash salts, they are used for that purpose in France.

(1) See R. 1912, No. 1147; R. 1914, No. 212; R. 1915, Nos. 467 and 688.

Extraction of iodine and bromine. — Inorganic iodides and bromides are easily obtained from kelp by simple lixiviation with weak acid or water. Organic compounds of iodine and bromine on the other hand cannot be completely extracted without destroying the mucilaginous residue unless an oxidising agent be employed in a faintly acid solution, according to the process patented in various countries (France, Germany, Austria, Belgium, England, Norway, United States and Japan).

1262 — *Green Manuring with Leguminous Crops in Java.* — RANT A., in *Mededeelingen van het Kóna Proefstation*, No. III. Batavia, 1915.

At Tjinjiroen, in the mountainous region of Java, experiments were carried out on the growth of various leguminous crops for green manure. The trial ground was 5160 ft. above sea level. An account is given of the plants tested with special reference to the formation of root nodules and to the appearance of disease.

1263 — *The Solubility of Phosphoric Acid in Mineral, Basic and Calcined Phosphates, and in Basic Slag.* — AITA A., in *L'Italia Agricola*, Year LV, No. 10, pp. 446-453. Piacenza, October 15, 1916.

Since the middle of the nineteenth century phosphatic manures have been employed chiefly as superphosphate and basic slag. In recent years, however, attempts have been made to re-introduce the use of natural phosphates in one of the three following forms: 1) ground phosphate which consists of the raw mineral reduced to a very fine state of division; 2) calcined phosphate or "thermophosphate" which is the mineral phosphate after simple calcination; and 3) basic phosphate, a product obtained by calcining the raw mineral with basic or alkaline substances. The writer has studied the solubility of mineral phosphates, more especially the less soluble ones, (*Annali di Chimica applicata*, July and August 1916) and gives a summary of his work in the present paper.

Mineral phosphates. — Recent experiments have shown that:

1) The power of assimilating phosphoric acid from mineral phosphates varies with the species of the plant, being marked in crucifers and hardly perceptible in cereals.

2) A very fine state of division increases the availability of mineral phosphates.

3) With phosphates in general, and particularly with the less soluble phosphates, the manurial value is dependent on: a) the lime content of the soil; b) the nature of the nitrogenous manure applied with the phosphate; c) the magnesium content of the soil. These three factors are referred to as the *calcium, lime and magnesium factors*.

It has been maintained that the slow availability of phosphoric acid in mineral phosphates is reflected in a low solubility in 2 per cent citric acid solution; but this hypothesis has since been disproved, it being shown that mineral phosphates yield the whole of their phosphoric acid to 2 per cent citric acid provided a sufficient amount of the solvent be used and the extraction be continued for a sufficient length of time. The writer subjected different types of phosphates (Tunisian, Algerian, Florida and Pacific)

to repeated extractions with 2 per cent citric acid, the samples being hand shaken for an hour at room temperature. It was found that the amount of phosphoric acid dissolved in the consecutive extractions varied not only according to the nature of the mineral and its lime content, but also according to its state of division :

1) Nodular and rock phosphates (Land Pebble, Medulla, Angaur) yielded their phosphoric acid less readily than the more friable minerals of a sedimentary origin, nodular phosphates requiring 7 extractions and rock phosphate 5 or 6 extractions for the complete removal of the phosphoric acid.

2) A Bir el Afou phosphate, ground to a degree of fineness which allowed 85 per cent of it to pass through a sieve with 100 meshes to the inch, yielded 29 per cent of its phosphoric acid in the first extraction and required 4 further extractions for the complete removal of the phosphoric acid, whereas an Egyptian phosphate of 58 per cent fineness only yielded 21.71 per cent of its total phosphoric acid to the first extraction, and for the complete removal of the phosphoric acid, 5 further extractions were necessary.

3) Calcium carbonate when present, neutralised the citric acid, thereby reducing its solvent power in proportion to the amount of carbonate present. In the first few extracts obtained from a calcareous sample, a Gouraya phosphate containing 21.22 per cent of calcium, the phosphoric acid increased whilst the carbonate decreased. On the other hand with Constantine, Gafsa and Bir-el-Afou phosphates containing only 13.27, 10.10 and 9.95 per cent of carbonate respectively the amounts of phosphoric acid found in the extracts followed a regular descending curve from the first to the last of the extractions.

In a second series of experiments a study was made of the influence of the other salts used as fertilizers (sulphates, nitrates and chlorides of ammonium, potassium, sodium and magnesium) on the solubility of phosphoric acid. Citric acid solutions were prepared containing increasing fractions of the equivalent weights of these salts and in each case 250 cc. of the solution was shaken up with 2.5 gms. of the raw phosphate for an hour. With the system ; tricalcic phosphate, phosphoric acid, calcium citrate and citric acid it was found that the solvent action of citric acid ceases on the establishment of equilibrium between the free phosphoric acid and the calcium citrate which is formed. The presence of a salt of a strong acid, such as potassium sulphate, upsets this equilibrium by causing a double decomposition between the added salt and the calcium citrate ; potassium citrate is formed and acts further on the tricalcium phosphate until a new equilibrium is established, this time between the two salts with a common ion, potassium sulphate and potassium phosphate. Nitrates and chlorides of ammonium, potassium, sodium and magnesium behave in an analogous manner. On the other hand the presence of calcium salts (chloride and nitrate) inhibits the solvent effect. The general conclusion may be drawn that the solubility of phosphoric acid is increased by the addition of salts of strong acids giving rise to soluble phosphates, and is decreased by the

addition of salts of acids weaker than citric acid owing to the fact that in such cases (e. g. carbonates) the citric acid displaces any such acid rapidly and loses part of its solvent power in the process.

Assuming that the reactions in the soil are analogous to those described above, the following practical conclusions may be drawn: 1) Fertilizers containing calcium salts lower the availability of phosphates; 2) nitrogen and potash manures in the form of sulphates, nitrates and chlorides increase the availability of phosphates in the order given; 3) magnesium sulphate, nitrate or chloride acts in a similar fashion.

Calcined and basic phosphates. — The writer states that the calcining process merely raises the cost of the product without rendering the phosphoric acid more soluble.

With regard to the production of basic phosphates, so far the only process working on an industrial scale is in Sweden where 20 000 tons of «Wiborgh» phosphate are turned out per annum. Ground apatite is heated with alkaline sulphate to a red or yellow heat and the product contains phosphoric acid which is soluble in 2 per cent citric acid. It has been thought that the tricalcic phosphate combines with the alkali at high temperatures to form a tetracalcium phosphate ($5\text{CaO} \cdot 2\text{Na}_2\text{O} \cdot \text{P}_2\text{O}_5$ or $5\text{CaO} \cdot 2\text{K}_2\text{O} \cdot 4\text{P}_2\text{O}_5$) analogous with the one believed to exist in basic slag. The writer, however, does not accept the view that this compound exists either in Wiborgh phosphate or in basic slag, and believes that the increased quantity of soluble phosphoric acid in the former is due to the presence of alkaline sulphates.

Basic slag. — A series of experiments was undertaken to throw light on the question as to whether the solubility of the phosphoric acid in basic slag is due to some of the secondary products contained in the slag. The phosphates were treated with citric acid in the presence of: iron and aluminium filings, ferrous sulphate, ferric chloride, aluminium sulphate, manganese sulphate and hydrate and magnesium silicate. The following results were obtained:

1) Silicates exerted a retarding effect on the solubility of the phosphoric acid, silicic acid being weaker than citric acid. Manganates behaved in a similar manner.

2) Ferrous sulphate and manganese sulphate behaved exactly like ammonium sulphate, alkaline sulphates and magnesium sulphate, the solubility of the phosphoric acid increasing with the concentration of these salts.

3) The same is true in the case of ferric and aluminium salts the presence of a very small quantity of these salts being sufficient to increase markedly the solubility of the phosphoric acid. It is stated that the increased solubility here is due to the combined effect of two distinct causes: a) the shifting of the equilibrium by the slag, and b) the formation of a complex salt of iron or aluminium with citric or phosphoric acid. This complex salt undergoes little dissociation and causes a radical change in the equilibrium of the system: tricalcic phosphate, phosphoric acid, calcium citrate, citric acid and ferric or aluminium salts. The fact that similar results were

obtained whether iron or aluminium filings were employed confirmed the deduction that the citrophosphate group was intimately connected with the iron or aluminium.

It has been shown previously that all the secondary products contain in basic slag are dissolved by 2 per cent citric acid to an extent which varies with the nature of the slag. The writer found that by using a solution of saccharose to remove the lime the solubility of the phosphoric acid was increased, likewise that of all the other constituents. The secondary compounds of slag can therefore be classified into two groups: 1) those which hinder the solubility of phosphoric acid (lime, silica, silicates, and manganese), and 2) those which assist it (sulphates, iron and aluminium). Among the latter group the sulphates may be neglected as they are only present in minute quantities but the presence of the two metals not only counterbalances the effects of the first group of substances, but actually exerts a definite solvent action on the phosphoric acid.

Conclusions. — Basic slag like the mineral phosphates contains phosphoric acid in the form of tricalcic phosphate. Their relatively high degree of solubility in citric acid as compared with mineral phosphates is attributed to the presence of iron and aluminium in the slag. The difference in the solubility of slags may be due to any or all of the following three causes: 1) a variation in content of iron and aluminium; 2) the percentage of soluble phosphoric acid present; 3) the presence of other bodies which exert a retarding effect on solution.

1264 - **Nitrate of Soda and Ammonium Sulphate on Sugar Cane in Java**
GEERTS J. M., in *Mededeelingen van het Proefstation voor de Java-Suikerindustrie*, No. 9, pp. 223-305. Soerabaja, 1916.

Experiments have been carried out in Java during the last few years to compare the manurial value of sodium nitrate and ammonium sulphate for sugar cane (1). These have shown that ammonium sulphate gives the best results on sandy soils and sodium nitrate on heavy land.

Where nitrate was used no deleterious action on the structure of soil was observed, nor is there any likelihood of this occurring in Java where the nitrate is not applied every year and further the land is irrigated. Owing to its extreme solubility nitrate is specially adapted to regions of low rainfall and gave the best results when applied in two or three dressings. It did not retard the ripening of the crop.

In Java ammonium sulphate is the more suitable manure in the majority of cases, and, unless supplies fail or the price of nitrate falls, it will continue to be the more popular fertiliser.

1265 - **Manurial Trials in Java.** — DE JONG A. W. K., in *Mededeelingen van het Agrarisch-Chemisch Laboratorium*, No. XII, pp. 1-27. Buitenzorg, 1916.

A report is given of manurial trials in Java during the year 1915. With manioc, sodium nitrate had an excellent effect especially with

(1) See R. June 1916, No. 647.

sed in conjunction with superphosphate or basic slag. It proved superior to ammonium sulphate.

With rice, calcium cyanamide and ammonium sulphate were equally successful and both were superior to nitrate. Applications of molasses had no appreciable effect. A double superphosphate was tested against Angaur phosphate and it was shown that in order to obtain the same results the dressing of Angaur phosphate had to be three times as large as that of the double superphosphate. The land was treated with sulphuric acid to destroy the weeds, and no ill effects could be detected on the subsequent rice crop.

With citronella grass (*Andropogon Nardus*), vulcanphonolite (1) produced no effect. The best results were obtained with a complete manure consisting of ammonium sulphate, potassium sulphate and double superphosphate.

166 - **The Flora of the Belgian Coast.** — MASSART J., (Brussels University) in *Annales de Géographie*, Year XXV, No. 137, pp. 321-327. Paris, September 15, 1916.

An account is given of the evolution of the flora on the Belgian coast with special reference to its origin. No endemic species has been evolved in the Belgian coast. Fossil plant remains are rarely found, but such as are found, e. g. the sea buckthorn (*Hippophae ramnoides*) would indicate that in the pleistocene period when the region was inhabited by reindeer, the land was occupied by a flora adapted to a colder zone, and that with the return of a more temperate climate both fauna and flora retreated northwards.

The majority of the members of the present flora must have originated by immigration. The writer classifies the species into two groups, a smaller one containing plants peculiar to the coast land and a much larger group made up of the more abundant species. The latter are found equally in the more inland tracts and for the most part originated from the Flemish sands. A few calcicole species such as *Helianthus vulgare* must have migrated from the more distant calcareous regions of the Meuse or the as de Calais. Finally the true marine plants whether distributed on the dunes or on alluvial land can only have come from other coastal regions. The study of the geographical distribution of 69 of these species in Europe revealed the fact that the majority of the species are characteristic of a warmer climate. In other words the migrations from the south have been far more frequent than those from the north.

167 - **Nitrogen Fixation, Nitrification, Denitrification and the Production of Sulphur-
-eluted Hydrogen by Bacteria in the Arctic Ocean.** — ИССАЧЕНКО Б. П. (ISSATCHENKO B. L.) in *Журналъ Опытной Агрономии имени П. С. Коссовича* (Review of Agricultural Experiments dedicated to the memory of P. S. Kossovitch), Vol. XVII, No. 2, pp. 175-179. Petrograd, 1916.

In 1906, a scientific and commercial expedition left the Murmanian coast (Province of Archangel) and travelled to the 73° lat. north on the coast of Novaya Sembya (an island bounding the sea of Kara on the west.) A

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(1) The trade name given to a ground phosphate.

full report of the bacteriological work accomplished on this expedition has recently been published by the Russian Department of Agriculture (1) and the present paper merely summarises the report.

The bacteria in the Arctic Ocean were investigated in order to determine their influence, direct or indirect, on the organic life of the ocean. In 1890-1891, investigations of a similar nature were already being carried out by Russians in the Black Sea and the production of sulphuretted hydrogen was observed. But with regard to the northern waters, though there were grounds for believing that they contained an active bacterial flora actual experimental data was very scarce. In 1899 some results were published stating that from 11 cc. of water only one colony had been obtained. In 1907 investigations were begun in the waters of the South Pole, but these hardly dealt with the action of specific organisms. Nevertheless it was the results of these experiments together with the fact that denitrification does not usually take place at temperatures much below about 20°C. which gave rise to the theory known as Braundt's hypothesis, i. e. that the distribution of plankton in the ocean is controlled by the supply of combined nitrogen according to Liebig's Law of the Minimum and that the combined nitrogen in its turn is dependent on the activity of the denitrifying organism; therefore that the relative abundance of plankton in the arctic seas compared with warmer waters is due to the absence of denitrifying bacteria.

In the Murman expedition *Clostridium* and *Azotobacter* were isolated from the mucilaginous surface of seaweed on which they live and from which they draw the necessary energy for growth and nitrogen fixation. Both organisms developed best in media containing sea salt. In sea water as in soil they were always accompanied by Winogradski's α and β bacilli. It would appear that a certain amount of symbiosis must occur between the nitrogen fixing organisms and the seaweed and that the organisms provide a very useful addition to the seaweed's food supply, given the natural deficiency of nitrogen in sea water.

Though nitrifying bacteria were found in the Gulf Stream at 72° lat north near Iekaterininsk and in the Ugorskij Sharr, their presence in arctic seas is still unproved. It is pointed out that the low temperature, which might be looked upon as causing complete inhibition, while it slows down the process of nitrification, never entirely stops it even at 20°C.

Denitrifying bacteria were found fairly abundantly in the Arctic Ocean and they were studied in some detail. Even after four years' cultures of non spore-forming bacteria retained the power of decomposing nitrates and setting free nitrogen. Under perfectly anaerobic conditions

(1) Б. Л. Исаченко, Исследования надъ бактеріями Сѣвернаго Ледовитаго Океана. Съ 3 таблицами и 63 рисунками I—VII + 297 стр. (Групи Мурманской Научно-Промысловой Экспедиции 1906 года. Издание Департамента Земледѣлія. Петроградъ. 1914). [ISSATCHENKO B. L., Research on the bacteria of the glacial Arctic Ocean, 297 pp., in Report of the Scientific and industrial expedition of Murman (1906). Petrograd, 1914].

nitrification was suspended, but a very limited supply of oxygen (microaerophily") favoured the process. Low temperatures of 0° to 3° C. do not inhibit denitrification. As a result of his experiments, the writer concludes that denitrification is quite possible in the Arctic Ocean and that Brandt's hypothesis is not confirmed by the facts observed.

Finally, arctic waters were shown to contain two kinds of bacteria capable of producing sulphuretted hydrogen, one from sulphates (*Microstira castuarii*) and the other from organic matter. It is pointed out that the formation of black mud on the coasts of Murman and Novaya Zembla and in Moughilnoie Lake in the Island of Kildine is due to the activity of these bacteria, more especially *M. castuarii*.

1. - **The Optimum Temperature of a Diastase is Independent of the Concentration of Substrate and Enzyme.** — COMPTON A., in *Annales de l'Institut Pasteur*, Vol. XXX, No. 9, pp. 496-502. Paris, September 1916.

In a previous investigation (1) it has been shown that the optimum temperature of a salicinase from sweet almonds is independent of the concentration of the substrate and of the enzyme itself, provided the duration of the enzyme action remain the same. In order to determine whether the statement would hold for enzymes in general, a similar series of experiments was carried out with the maltase of *Asterigillus Oryzae* or takadiastase. Kahlbaum's purified maltose was employed and the diastase solution was obtained by macerating 1 gm. of the diastase powder in 100 cc pure water at room temperature. Then using solutions of hydrolysed maltose of the following molecular concentrations: M/5, M/10, M/20, M/30, the activity of the enzyme was determined at temperatures varying from 15 to 56.4° C.

To measure the influence of the concentration of the diastase, solutions were prepared with 0.1, 0.3 and 0.6 gms. of diastase powder per 100 cc water as well as the standard solution given above. Again, in all four cases the optimum temperature was 47° C.

The writer is of opinion that with diastase fermentations the optimum temperature is always independent of the concentration of the substrate and of the enzyme. This fact is of practical importance as it means that the molecular concentration of the substrate solutions is not an important factor and need not be considered when substances such as glycogen, starch and proteins are used, whose molecular concentration is unknown.

2. - **On the Reduction of Nitrate by Plants with Evolution of Oxygen.** — MOLLARD M., in *Comptes Rendus des Séances de l'Académie des Sciences*, Vol. 163, No. 15, pp. 371-373. Paris, October 9, 1916.

There are grounds for believing that nitrates are reduced in the leaves of plants and it has been suggested that there might be a resulting evolution of oxygen. An attempt was made to show that such an action

(1) ARTHUR COMPTON, in *Proceedings of the Royal Society*, B. 87, 1914, P. 245; *Annales de l'Institut Pasteur*, Vol. XXVIII, 1914, P. 866.

took place by comparing the gas formed by two plants, one of which was supplied with nitrogen in the shape of nitrate and the other with ammonium salts.

Radishes were grown in long necked flasks each of which was connected with a mercury manometer. The culture medium consisted (per flask) of 60 cc of fine broken pumice and 40 cc of nutrient solution containing nitrogen at the rate of 6.0 gm. of ammonium chloride or 1 gm. of potassium nitrate per litre. Throughout the experiment aseptical conditions were maintained. As soon as the seeds had been sown the neck of each flask was sealed enclosing a volume of air which amounted to about 120 cc. Every day manometer readings were taken not only for the flasks containing plants but also for a control flask, so that corrections for pressure and temperature could be made.

After 35 days a plant receiving ammonium chloride had produced 0.994 gms. of green weight or 0.153 gms. of dry matter. The internal pressure of the flask fell for the first 9 days and then rose till it attained 2.1 cms. of mercury, which was equal to 2.77 cc of oxygen and brought the total amount of oxygen up to 22.5 per cent of the atmosphere in the flask. At the end of the experiment the respiration quotient was determined, a value of 1.02 was obtained.

Where the plant was supplied with nitrate, 0.264 gms. of dry matter were produced in 35 days and the internal pressure rose to 8.6 cms. of mercury. The oxygen in the flask was increased by 13.74 cc. raising the percentage in the flask to 28.8. The respiration quotient was 1.07.

The fact that the flask containing nitrate increased its pressure more than the flask containing the ammonium salt led the writer to conclude that oxygen had been set free from the nitrate. Assuming that the increase in pressure for plants growing in the same medium is proportional to dry matter produced, the excess of oxygen in the nitrate flask was determined, and it was found that for every atom of nitrogen fixed by the plant two atoms of oxygen had been set free.

1270 - **The Assimilation of Iron by Plants.** — Сидоринъ М. И. (SIDORINE M. Московский Сельско-хозяйственный Институтъ; Кафедра Частнаго Заведѣнія. Изъ результатовъ вегетационныхъ и лабораторныхъ работъ Годъ 19-й. Томъ X-й, подъ редакціей профессора Д. Н. Прянишникова (Moscow Agricultural Institut, Prof. PRYANISHNIKOV's Laboratory, Results of its cultures in 1914) Vol. X, pp. 241-257. Moscow, 1916.

The assimilation of iron by plants was studied in a series of water cultures and sand cultures carried out at the Agricultural Institute at Moscow. A first experiment with water cultures was undertaken to determine the influence of carbonates on iron assimilation; the following nutrient solutions were used:

a) Knop's normal culture solutions containing per litre:	
Calcium nitrate	1 gm.
Potassium nitrate	0.25 "
Potassium chloride	0.25 "
Potassium sulphate	0.25 "
Potassium phosphate	0.25 "
Ferric phosphate	0.20 "

b) Knop's "acid" culture solution containing per litre :

Calcium sulphate	1.12 gm.
Ammonium sulphate	0.45 "
Sodium nitrate	0.42 "
Potassium phosphate	0.27 "
Potassium chloride	0.15 "
Magnesium sulphate	0.12 "
Ferric phosphate	6.20 "

These were modified according to the scheme given below.

- 1) Knop's normal culture solution
- 2) " " " " without iron.
- 3) " " " " " sulphur.
- 4) " " " " " magnesium.
- 5) " " " " + 8 gms. calcium carbonate.
- 6) " " " " + 4 " magnesium carbonate.
- 7) " " " " + 2 " sodium carbonate.
- 8) Knop's "acid" culture solution
- 9) " " " " + 8 gms. calcium carbonate.
- 10) " " " " + 4 " magnesium carbonate.
- 11) " " " " + 2 " sodium carbonate.

In all cases where carbonates were present chlorotic plants were obtained, the effect of the three carbonates being identical. When a very little phosphoric acid was added, a green colour appeared at the base of the most leaves. The amount added was sufficient to give the nutrient medium an acid reaction, and in a later set of experiments the phosphoric acid was replaced by hydrochloric, sulphuric and nitric acids with the same result, showing that the antichlorotic action was due to the acidity of the solution and not to the presence of phosphorus. The exclusion of magnesium had no appreciable effect on chlorosis, but the plants without sulphur were affected though not quite in the manner described by MAZÉ. According to the latter, chlorosis caused by the absence of sulphur is identical with chlorosis caused by the absence of iron, whereas in the present experiments, sulphur chlorosis was somewhat later in appearing and the colour of the leaves was never quite the same in the two cases.

For the sand cultures the same scheme was adopted as for the water cultures but Hellriegel's nutrient solution was substituted for Knop's. Pots with a capacity of 4 ½ litres were used. The results obtained were somewhat different from those of the water cultures and this was attributed to the nature of the medium which was never quite neutral.

The phenomenon of chlorosis was then studied in greater detail by the method of "isolated nutrition" or in other words by dividing the root system into two parts, one of which received the iron alone, or iron and carbonate alone, and the other the rest of the food solution. Where a carbonate was added, chlorosis appeared as before, but where iron was used alone, variegated leaves were obtained. In the majority of cases one half of each leaf was yellow and the other half green, but sometimes there was a green band in the middle with yellow on either side, or the leaf might

even have a yellow ground with green ribs. This last phenomenon was observed for the first time 8 or 9 days after the experiment had begun on the third, fourth and fifth leaves. Small drops of ferric chloride placed on the yellow parts of the leaves immediately caused green spots to appear. As the plant got older the coloration changed. The sixth leaf always had green ribs and the seventh was wholly green; the variegations of the fifth tended to become less sharply defined, but the third and fourth leaves remained unchanged.

When a few drops of phosphoric acid were added to the cultures containing carbonates, a faint greenish colour appeared at the base of the leaves after 3 or 4 days; and plants grown in pots with calcium carbonate were injected with 0.25 cc of ferric chloride solution (0.03 per cent) which produced a green coloration in the parts above the point of injection. In all the experiments on variegation, not only maize was used but also sorghum, barley, buckwheat and beans; the last two plants, however, did not behave in the same manner as the other three.

A last set of experiments was carried out with the nutrient solution of Hellriegel, Prianichnikov and Crone in order to test Benecke's theory of chlorosis which was fully confirmed.

Conclusions. — When plants are grown in culture solutions containing free carbonates, the chlorosis produced is due to the alkalinity of the carbonates, more especially of calcium carbonate. This alkalinity is not however a direct cause of chlorosis, but acts indirectly by making the iron inaccessible to the plant. Such effects may also occur under natural conditions if the food solution be physiologically alkaline.

The property possessed by iron of forming almost insoluble salts with phosphorus prevents iron assimilation from taking place in nutrient solutions.

Chlorosis may be caused by absence of sulphur as well as by absence of iron.

There are often essential differences between the results obtained in sand and in water cultures.

Iron is particularly interesting in its strictly localized assimilation in plant tissues, as shown by the experiments on "isolated nutrition". This should prove a means of obtaining valuable material for the study of problems connected with the internal structure of plants.

1271 - **Influence of Calcium and Magnesium Compounds on Plant Growth.** — WAX F. A., in *Journal of Agricultural Research*, Vol. VI, No. 16, pp. 589-619. Washington, D. C. July 17, 1916.

Experiments were planned with the idea of studying the effects of calcium and magnesium upon plant growth when applied in different natural and artificial forms. Studies were made to determine the amount of calcium and magnesium which plants could tolerate. The relation between the ratio of these two elements in the plants, in the soils, and in the materials supplied was also studied.

Dolomite, limestone, magnesite, calcareous soils, and brown silt loam were used as sources of the natural forms, while prepared materials, such

the carbonates, chlorides, and sulphates, served as sources of the artificial forms. Increasing amounts of the various forms were used, also a variance in the ratio of calcium to magnesium was employed. The earlier applications varied from 0.1 to 0.6 per cent of magnesium added in magnesium carbonate and in magnesite. Later the following amounts were employed: 2.6, and 10 per cent of magnesium in magnesite; 10 and 12.7 per cent in dolomite; 0.1, 0.01, and 0.001 per cent of magnesium in the carbonates, chlorides, and sulphates.

Earthen pots 6.5 ins. in diameter by 7.5 ins. in depth were used. Each pot contained 13.2 lbs. of sand, while in the soil series each contained 8.8 lbs. of brown silt loam. Sand and soil were used as mediums of control, and to these two materials were added the various forms and amounts of calcium and magnesium.

Various methods were pursued in extracting the sand. At first dilute hydrochloric acid was kept in contact with the sand for 48 hours, but this failed to remove all the calcium and magnesium. Later the sand was extracted with stronger acid (1350 cc of concentrated hydrochloric acid with 1000 cc of distilled water) for periods of from 9 to 14 days. Sand was also digested on a steam bath for 4 days with this same strength acid. None of the above processes were able to remove all the calcium and magnesium from the sand. After treatment it still contained:

	Calcium	Magnesium
Extraction with dilute acid for 2 days	0.0142 per cent	0.016 per cent
" " strong " " 4 "	0.0128 " "	0.0089 " "

At intervals varying from 10 to 14 days, nutrient solutions were added to the pots and every 10 days the pots were brought to standard weight by watering with distilled water. The experiments were run in greenhouses and the principal crops used were: wheat (*Triticum* spp.), alfalfa (*Medicago sativa*), soybeans (*Glycine max*) and cowpeas (*Vigna sinensis*). Oats (*Avena sativa*), clover (*Trifolium pratense*), timothy (*Phleum pratense*), and sweet clover (*Melilotus alba*) were also used to test the effect of artificial carbonates upon germination.

The experiments reported here extended over a period of three years 1912 to 1915 and include approximately 300 pot cultures and upwards of 300 duplicate determinations of calcium and magnesium.

Difficulty was experienced in finding a medium that was free from calcium and magnesium, and which would still approach soil conditions. Attempts were made to grow plants in aluminium turnings but without success, probably due to the formation of some aluminium salts when the plant foods were added.

Wheat and cowpeas grown in granular paraffin without the addition of calcium and magnesium showed in the total plant only an amount equal to that furnished by the seed.

The difference in the medium in which the plants were grown caused different effects upon the plants. Brown silt loam was a better medium than sand when treated with chemically pure magnesium carbonate, even

though it already contained 25 times as much calcium and magnesium as did the sand. Still sand would have an ameliorating effect when compared with water cultures. JENSEN found that in quartz sand a much higher concentration of salts was required to cause death than in water cultures.

It is quite generally believed that plants have to some extent a selective absorption. The results here seem to indicate such a condition, for the dolomites used tend to go into solution in a molecular ratio, but the plants failed to take them up in this ratio. The tendency of the plants under these conditions was to take up relatively larger molecular proportions of magnesium than of calcium. Analysis of the plants show that they do not necessarily take up calcium and magnesium in the same ratio as applied, as, for example, in dolomite C₃ the ratio of calcium to magnesium is 5 : 5.2, while the plants may and do take it up in a ratio of 5 : 7 or 5 : 3.95.

In the case of the addition of 25 per cent of magnesite the ratio of calcium to magnesium was 5 : 125, while in some of the plants grown in such treatment the ratio varied from 5 : 15 to 5 : 21. Wheat grown in soil treated with 6 per cent of dolomite showed in the tops a ratio of 5 : 9.1 and in the roots a ratio of 5 : 4.35, or for the whole plant a ratio of 5 : 6.3, while in dolomite C₁ it was 5 : 4.8. Alfalfa grown in the same treatment showed for the entire plant a ratio of 5 : 4.2, but when grown in soil treated with dolomite C₃ the ratio for the total alfalfa plant was 5 : 3.95.

The chlorides of calcium and magnesium were more detrimental to wheat and soybeans than were the sulphates at concentration up to 0.1 per cent of magnesium. This amount of magnesium in the prepared carbonate entirely inhibited growth whereas lower concentrations gave better growth than either in the sulphates or chlorides.

Wheat 65 days old showed smaller percentages of calcium and magnesium than did similarly treated wheat at 53 days of growth, but the total amount of these two elements in the plants increased with the duration of growth.

Soybeans at maturity, or 80 days after planting, showed for the hay higher calcium and magnesium contents than at 53 days of growth, except in the case of the checks and those treated with extremely small quantities. Some of the samples showed as much as 73 lbs. of calcium and 25.2 lbs. of magnesium per ton when grown in a mixture of one-half sand and one-half calcareous soil, but when grown in soil containing 35 per cent of magnesite there were 22.9 lbs. of calcium and 42.3 lbs. of magnesium, per ton; whereas the checks contained 5.8 lbs. of calcium and 5.6 lbs. of magnesium.

Wherever excessive amounts of magnesium were applied, there was a characteristic appearance of yellow leaves. The uppermost leaves became yellow and gradually died, while the lower leaves remained green. This condition is characteristic of magnesium sickness and just the reverse of the effects produced by translocation processes.

The general tendency is for the percentages of calcium and magnesium in the plants to increase with the increase of size in application. Likewise a high magnesium content in the plant tends to accompany plant sickness.

sickly and healthy leaves from the same soybean plant, showed respectively, 1.11 per cent of magnesium as against 0.88 per cent magnesium.

All varieties of the seed used contained more magnesium than calcium, while ordinarily the remainder of the plant contained more calcium than magnesium.

Nitrogen was applied to the legumes as well as to the cereals, so as to be sure that this was not the limiting factor.

Conclusions. — 1) Wheat, soybeans, alfalfa, and cowpeas grew normally either in 96 per cent of dolomite and 4 per cent sand, 100 per cent of magnesian limestone, or in sand containing 7 per cent of magnesite.

2) Dolomite up to 40 per cent proved beneficial to plant growth. These results indicate that dolomite and magnesian limestone will not be detrimental as applied in agricultural practice.

3) Applications of prepared magnesian carbonate up to 0.7 per cent caused no injury in brown silt loam, but 0.35 per cent prevented the growth of all plants tested in sand.

4) The crop yields and the ratio of calcium to magnesium within rather wide limits produced no marked differences in yields.

5) Different ratios of calcium to magnesium within rather wide limits produced no marked differences in yields.

6) Increasing the size of applications increased the calcium and magnesium content of plants.

7) A tolerance of calcium and magnesium occurred in all varieties plants grown. With approximately identical yields, wheat straw grown sand, brown silt loam, dolomite, and soil containing 35 per cent of magnesite showed calcium contents varying between 0.165 per cent and 0.547 per cent and magnesium contents varying between 0.132 per cent and 0.955 per cent.

8) Acid extractions failed to remove all the calcium and magnesium from the sand. There remained after the various extractions from 768 to 52 mgms. of calcium and from 540 to 960 mgms. of magnesium per 6000 mgms. of sand.

9) The plants possessed a decided ability to obtain calcium and magnesium from sand extracted with strong hydrochloric acid, as borne out by the following example: Three crops of alfalfa removed from acid extracted sand 164.43 mgms. more calcium, and 90.4 mgms. more magnesium than was contained in seeds similar to those planted.

— *Etiolated Cereal Plants.* — KALT B., in *Zeitschrift für Pflanzenzüchtung*, Vol. 1, No. 2, pp. 143-150, Berlin, June 1916

Many references have been recently made to the appearance of etiolated plants and the present paper describes some investigations made in 1915 at Agricultural Institute of Halle University, Germany.

1. *Barley.* — A plant of a pure line of Groninger Wintergerste was crossed in 1915 with pollen from a pedigree plant of original Pückendorfer Mamt-Wintergerste. The F_1 generation gave about 30 perfectly normal plants of which 26 were chosen for propagation. The descendants of 25 of these plants were quite normal in appearance, but from the last one (Elite $1/14$)

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BREEDING

some white plants were raised in addition to the normal green ones. Nine out of 100 seeds of Elite $1/14$ germinated; of these 75 plants were normally green and 15 (representing 16.6 per cent) were pure white without a trace of green colour. These white plants developed normally as long as the reserve food materials in the seeds lasted; they formed two leaves of normal size and thickness, but after 3 or 4 weeks they died because assimilation could not be carried on. Of the 75 green descendants of Elite $1/14$, 47 were eaten by insects during the year, 28 plants were harvested and 6 of these were selected for further investigation. All the seeds from these 6 plants were sown separately in autumn 1915. The other 22 plants were harvested and sown together.

The descendants of two of the 6 plants which were sown separately were normal and green, those from the other 4 being mixed. From the batch of 22 plants 10 960 seeds were sown and 9 646 plants were obtained, of which 8 412 were normally green and 1 234 were white. Theoretically these figures may be explained thus.

C = presence of chlorophyll (dominant)

c = absence of chlorophyll.

Generation P_1 :	C			c
Generation F_1 :		Cc		
Generation F_2 :	CC	Cc	Cc	cc

If the 22 plants had all been equally prolific each plant would have produced 438 descendants, so that in F_2

CC	Cc	Cc	cc
3 215	6 430		0

The 3 215 CC are constant in the F_3 generation; the 6 430 Cc, on the other hand, subdivide thus:

CC	Cc	cc
1 607	3 214	1 607

Thus there would be

3 215	homozygotes of F_2
1 607	homozygotes of F_3
3 214	heterozygotes of F_3

Total 8 036 green plants.

The theoretical calculation gives 8 036 green and 1 607 white plants in the F_3 generation, whereas actually 8 412 green and 1 234 white plants were obtained. This difference may be explained by the fact that an average number of grains was reckoned for each plant and also that only 22 plants, with a large number of tillers, were dealt with. The proportions between the numbers of green and white descendants of the six plants sown separately show quite clearly that etiolation is transmitted as a recessive character according to Mendel's law, thus confirming the results of NILSSON-EHLE, VESTERGAARD and MILES.

It is interesting to notice that in this case, in which the crossing was carried out in exact accordance with scientific rules, the characters were trans-

tted in the same way as in a crossing between green plants and white plants in which green is dominant. Thus when abnormal hereditary characters have appeared it has been possible to trace back the combination of factors Cc as far as their association at the time of hybridisation, and even examine pure lines to seek for the eventual presence of the factor c . In this investigation more than one half of the available seeds of two pure parent lines were sown (1 000 grains in each case) and it appeared that the factor c did not occur in these lines, because all the plants raised were normally green, whereas the heterozygotes Cc should have produced white descendants as well after self-fertilization. If one admits, with NILSSON-EHLE, that the cause of the appearance of white plants is a mutation in which a determinant chlorophyll factor has disappeared, this mutation, called a mutation of loss, must have occurred at the time of hybridisation; for, on the one hand, the parents were pure, and on the other hand, the first appearance of the white plants in the generation F_2 and their definite mendelianism proves that the first association of C with c occurred in the generation P , i. e. in the hybridisation itself.

As was shown at the beginning the crossing gave about 30 plants, of which 26 were used for continuing the investigation. These all had the same plant as mother and also the same male parent, as the pollen used for fertilization was all taken from a single plant. Only one of these 26 plants had any white descendants. The inevitable conclusion is that the supposed mutation had not affected the whole of the male or female parent, but only some of the gametes, possibly even one gamete only. It is obvious that of the 2 gametes (26 male, 26 female) which entered into combination in this cross only one, either male or female, possessed the factor c , a predisposition to the absence of chlorophyll.

As in this case the factor c appeared at the time of crossing the idea naturally suggests itself that the fact of crossing played a part in the formation of white descendants, and perhaps even caused the mutation. This hypothesis is favoured by the fact that up to the present white individuals have been chiefly noticed among cross pollinated plants. During the researches on etiolated plants the author of this paper has found about 1 000 white descendants in rye, 1 in 6-rowed barley, one in 2-rowed bent-eared barley, 1 in oats, none in erect-eared barley and in wheat.

With a view to solving these problems it is intended, during the next few years, to grow both singly and in mass the pure lines from which the white plants were descended.

II. *Rye*. — In the autumn of 1915, 44 out of 104 lines (nearly 50 per cent) of Saaleroggen (rye from the Halle district on Saale) divided up into green plants and white plants. Nevertheless, in each line the proportion of white plants never exceeded 10 per cent and on the average did not even reach 5 per cent. The reason of this was that in rye after the crossing Cc in the generation F_1 no self fertilization occurs such as is necessary to produce the mendelian numbers, but, on the contrary, the heterozygous lines Cc are fertilised by foreign homozygous (CC) or heterozygous (Cc) pollen: it is only in the latter case that white plants can appear in the F_2 .

generation. If all the ovules were fertilized by heterozygous pollen 25 per cent of white individuals could be produced. As this probability is excluded this 25 per cent represents the maximum theoretical limit of probability, and the actual number of white descendants appearing in the F_2 generation of a single crossing is determined only by the frequency with which plants predisposed to lack of chlorophyll occur in the neighbourhood. This explains why the number of white plants appearing in a single line or rye is relatively so small, although such plants occur in a large number of lines.

It is evident that the appearance of white plants is of extraordinary frequency in the rye under discussion. On the other hand such plants were rarely seen in 30 other kinds of rye grown at the Experimental Station. Saueroggen is a local variety peculiar to the environs of Halle and it has been grown for a long time without the introduction of fresh blood. As it has been grown by in-breeding there is every reason to believe that this method of cultivation is the cause of the lack of chlorophyll. This hypothesis is rendered more probable by the fact that the appearance of white plants seems to increase steadily in spite of the dominance of the factor "presence of chlorophyll".

As in the observations made by NILSSON-EHLE, the heterozygous plant of barley and rye which are the parents or even the sister-plants of the albino in the Halle district are in no way different from the normal homozygous plants of the variety. The green chlorophyll is strongly dominant, but this dominance seems only to occur in indigenous cereals, as EMERSON has found in Maize some heterozygous plants of an intermediate type striped with green and white.

1273 - **Two New Seedling Hops of Commercial Promise.** — SALMON F. S., in *Journal of the Board of Agriculture*, Vol. XXIII, No. 1, pp. 47-51, London, April 1916.

In 1906 the writer commenced to raise new varieties of hops from seed obtained by artificial and by natural cross-fertilisation, and at the present time the Experimental Hop-garden at Wye College contains nearly 400 "hills" of seedling female hops and selected male hops. The commercial value of the most promising of the seedlings is now being tested.

In a preceding article (*Journal of the Board of Agriculture*, May 1915) attention was drawn to a new hop, the Foundling, which is resistant to the eelworm disease and shows other characters of commercial importance; in the present paper two other seedlings are described which appear worthy of more extended trial by the hop-growers of this country.

The first of these new varieties was raised in 1906 by pollinating variety White's Early with Early Bird. All the plants thus obtained show a resemblance to White's Early in earliness, in the large, bold, rather of hops with thin petals, and in possessing the delicate "Golding" flavo. Two or three of the seedlings show promise commercially, but only (No. 125), called Young Hopeful, has yet been tested sufficiently. The hops for several seasons have been favourably reported on by various experts. In 1910 and 1911 the hops contained 8.66 per cent of soft resins; in 1912 the percentage was 10.30. During the last three years cuts of this plant have

been sent to twelve localities in Kent and Surrey, and where the hop has become established favourable reports as to the growth have been received.

The second good hop, called Pickers Delight, is of unknown parentage; it was raised in 1908 from a seed collected in the Experimental Hop-garden at Wye College from a certain hop which showed the following characters: Early to mid-season, growth very vigorous, very fruitful, hop very large, oval, nice shape, dense, often with a tinge of red on the petals, flavour pronounced good in most cases, sometimes excellent. The seedling hop is now being grown experimentally in 12 places in Kent and in 2 localities in Surrey and Sussex.

274 - **The Value of Immature Potato Tubers as Seed.** — HUTCHINSON H. P., in *Journal of the Board of Agriculture*, Vol. XXIII, No. 6, pp. 529-539. London, September, 1916.

STARCH CROPS

Many practical potato growers believe that tubers lifted in an immature or unripe condition give better yields than fully ripened tubers. This has been confirmed by experiments carried out at Garforth (Yorkshire) in 1905 and 1906 with mid and late-season varieties, at Wye College (Kent) in 1912 and 1913, and at the Midland Agricultural College in 1914 and 1915.

At the Midland Agricultural College in 1914 the variety Factor yielded follows:

	tons	cwt	lbs
	—	—	—
Crop raised from ripe tubers.	12	4	72
Crop raised from immature tubers . . .	13	9	80

1915 the variety King Edward yielded:

Crop raised from ripe tubers.	6	4	62
Crop raised from immature tubers . . .	12	19	42

The use of immature tubers as seed gives plants that are earlier, more vigorous, and less attacked by diseases and pests, while the crops are earlier and heavier.

The superiority of immature seed may be due to the following causes:

1) *Method of selection.* — In usual farming practice the tubers retained for planting purposes are of medium and smaller sizes, the larger tubers being sold. For planting with immature seed the larger tubers are selected, which are mainly derived from the most productive plants, so that the resulting tendency is to increase, or at least to maintain, previous productivity.

2) *The structure of the tuber coats.* — The cortex of immature tubers is thinner, which facilitates evaporation, imbibition, respiration etc and consequently aids germination.

3) *The amount and condition of the reserve food material.*

4) *The length and time of storage.* — The immature tubers are given several weeks longer storage, so that a larger proportion of the starch is transformed into compounds that are more easily assimilated by the young plant.

1275 - **Potato Trials in Guernsey.** — MCFIE J.B., in *The Gardener's Chronicle*, Vol. LX No. 1555, pp. 180-181; London, October 14, 1916.

During the autumn of 1915 potato trials of some of the leading early varieties were carried out in Guernsey at the Brookdale Nurseries of Messrs W. Manger and Sons, with the purpose of ascertaining which were the most suitable for their district taking into account the cropping and cooking qualities. Land to the extent of one acre, on which bulbs had been grown for about ten years was set apart for the purpose and prepared as follows: Seaweed at the rate of 30 tons per acre was spread on the surface and allowed to lie for a month or so, after which it was dug in about 5 inches deep. That was in the fall of 1915. In January of this year the ground received a further dressing, but this time of stable manure at the rate of 20 tons per acre. This was ploughed in about 9 inches deep. At the end of February and early in March the trials were planted beginning with the first earlies. Two feet were allowed between the drills and about 16 inches between the sets. A liberal dressing of Peruvian guano was sown in the drills during the planting ($\frac{1}{2}$ ton to the acre), and as soon as the tops were clearly visible they were forked between and earthed up a fortnight later. At the end of May, when the plants were growing strongly, they were sprayed with Bordeaux mixture, and again after a fortnight. The result was that practically no blight (*Phytophthora infestans*) was seen on the early varieties. During the early part of July, the disease was noticed in the second early and main crop varieties. Fortunately, however, this only affected the haulm, as at digging time hardly 1 per cent of the tubers were affected, a result which is no doubt entirely due to the spraying with Bordeaux mixture.

The following are the average crops, per acre, obtained :

	Tons	Cwts
First Earlies : Midlothian Early	12	10
Sharpe's Express	12	8
Witch Hill	10	18
Dunottar Castle	10	14
Second Earlies : Great Scot	24	18
Edinburgh Castle	19	12
Dobbie's Favourite	19	12
Stirling Castle	15	10
Arran Chief	16	19
Suttons Flourball	14	17
White City	10	8

1276 - **Experiments on the Manuring of Potatoes in Germany.** — WEBER P. and K. BERGER, in *Journal für Landwirtschaft*, Vol. 61, Part 3, pp. 181-199. Berlin, October 19, 19

Experiments have been made to determine how the yields of potato and starch are affected on sandy soils, loams and clays, when a manure containing phosphate and potash is supplemented by one or other of the following nitrogenous fertilisers : ammonium sulphate, calcium cyanamid ammonium nitrate, purin.

In each experiment the manure applied per acre consisted of 3 $\frac{1}{2}$ cwt basic slag and 1 $\frac{1}{2}$ cwt. potash salts (40 per cent), together with the nitro

manure, either 1 ½ cwt. ammonium sulphate, 1 ½ cwt. cyanamide, ¾ cwt. ammonium nitrate or 281.6 gallons purin. The question of the effect of the nitrogen in purin and the commercial manures was approached after the nitrogen, potash and phosphate requirements of the soils had been determined. All the manures, except ammonium nitrate, were spread about a fortnight before seeding. The purin, which contained 4 parts per thousand of nitrogen, was distributed on two occasions, a fortnight and a week before planting. Half of the ammonium nitrate was applied as a top dressing, when the young plants appeared, and the other half about a fortnight later.

The soils used for the experiments were:

- 1) a very light sandy loam derived from the disintegration of banded sandstone, deficient in chalk and potash.
- 2) a stony diluvial soil, rather impervious, deficient in chalk and potash.
- 3) two siliceous loams of tertiary age containing plenty of chalk and a sufficiency of potash.
- 4) two clay soils derived from disintegrated basalt, containing a large amount of chalk and plenty of potash.

The farms on which the experiments were carried out are worked on the system of intensive cultivation.

The land was prepared about the middle of April, the manures were applied at the end of the month and Industry potatoes were planted in between May 7 and 11. The development of the crops was normal, those on the sandy land suffered from drought in the summer of 1915. The results of the experiments were set out in tables from which the following conclusions have been drawn, showing the great importance of use of manure:

- 1) Nitrogen is usually the factor which determines the yield of potatoes, particularly on good clay soils, but on sandy soils mineral manures (potash, phosphate) seem to be more important in this respect.
- 2) A maximum yield cannot be obtained on strong land without potash and phosphate manuring, even with heavy applications of nitrogen.
- 3) Of the nitrogenous manures tested ammonium sulphate always gave the best results on all types of soil, though cyanamide and ammonium nitrate were not far behind.
- 4) Purin gave such satisfactory results that it can be strongly recommended as a manure for potatoes.
- 5) The highest starch yields were obtained with potash and phosphates without the addition of nitrogen. Purin only caused a small reduction in the proportion of starch, while the other nitrogenous manures caused about a much greater decrease. The potato seemed to be very sensitive to the use of cyanamide and ammonium nitrate, as these manures caused rotting. Potash manuring always caused an increase in the proportion of starch.
- 6) The quantity of nitrogen applied in the manure is not always related by the crop yield. For example, ammonium sulphate, of which

only the 90 per cent was used on clay land, gave better results than ammonium nitrate was not completely assimilated by the plant or that was utilised for stem and leaf production to a greater extent than the ammonium sulphate.

7) The experiments show that the nature of the nitrogenous manure has a very great influence upon the utilisation of potash and phosphoric acid. These two substances are used to the greatest advantage in the presence of ammonium sulphate, ammonium nitrate and cyanamide, in the order named.

8) Purin is very satisfactory, especially on clay soils, so that it deserves special attention on this account.

FORAGE CROPS,
MEADOWS
AND PASTURES

1277 - **Pasture Problems: Indigenous Plants in Relation to Habitat and Soil Species.** — STAPLEDON R. G. and JENKIN T. J., in *Journal of Agricultural Science* Vol. VIII, Part I, pp. 26-64. Cambridge, September 1916.

The aims of the present paper are a) to trace the relationship that exists between the several indigenous plants that contribute to the herbage of different types of grassland:

b) to follow the progressive changes that occur on fields (down grass for a varying number of years,) belonging to these types;

c) to follow the competitive interaction between sown and indigenous species;

d) to contrast the effect on the herbage of continual mowing and continual grazing.

Most of the data presented are derived from investigations in South and Mid Wales, but occasional examples are given from North Wales and the Cotswolds.

A distinction is drawn between natural and semi-natural types of grassland. Natural types are those which historical evidence suggests have never been extensively under the plough or manured and which broken or manured at a remote period, have completely reverted to type. Semi-natural types are those which have certainly, at one time or another, been under the plough and, at all events, manured during the rotation previous to reverting to grass. The semi-natural types may be further classified as *untended*, those which have been ploughed and probably manured 50 to 100 years ago, and *tended*, those which have been down grass for 20 to 50 years.

Grassland plants may be divided into the following classes, which are applicable to all districts and to all types of grassland.

a) Primary indigenous species, which colonise natural grassland.

b) Secondary indigenous species, which come in without having been sown and which contribute largely to the herbage on semi-natural types of grassland.

c) Tertiary indigenous species, which come in by themselves on young leys but which disappear as the fields approach the semi-natural type.

d) Locally exotic species, which are indigenous to a district.

ch do not naturally contribute to the flora of a well marked type of island.

e) Exotic species, which are not indigenous in a district.

The number of primary species on most types of grassland is not considerable. When a field long under arable cultivation is put down to grass the primary species are usually late to come in; this is particularly true of *Bromus erectus*, *Molinia caerulea*, *Nardus stricta*, *Triodia decumbens* and *Festuca ovina*; and if they come in early, they do not rapidly make their contribution to the herbage, i.e. they may fall below their minimum exceed their maximum figures. Primary species which sometimes come in early are frequently met with as arable weeds, such as *Poa trivialis* and *Festuca rubra* at lower elevations and on the better soils, and *Agrostis vulgaris* on the poorer soils.

The various stages in the process of stabilisation of semi-natural grassland — through tending to untended and thence into natural types — may be summarised thus:

At 20-30 years, under the influence of periodic manuring and comparatively heavy grazing with cattle and sheep the secondary species (*Cynodon cristatus*, *Trifolium repens*, *Plantago lanceolata* etc) are still abundantly represented; the primary species (*Agrostis vulgaris*, *Festuca ovina* and the heath herbs) are, however, beginning to take a prominent place in the herbage.

At 50-100 years the primary species have gained considerably but do not yet stand in their normal relation to each other; the secondary species are much reduced.

After 100 years the influence of the original disturbance and of manuring is now finally lost; the grazing is generally by sheep only, the result being that the primary species have completely suppressed the secondary species.

The relation of primary and secondary species to their commercial and sown counterparts is as follows:

a) The commercial seed does not appreciably hasten the appearance or add to the contribution of the desired plant. This is true of sowing *Festuca ovina* or other fine leaved fescues and is, in many cases, equally true of *Anthoxanthum odoratum*; the inclusion of such seeds in mixtures is not justified economically. It is far from certain that the commercial *Trifolium repens* seed produces a lasting plant, as on many soils phosphatic manure is all that is necessary to hasten the appearance of the indigenous plant.

b) The commercial seed may produce a great bulk of the required plant in the early years of a ley (far more than the indigenous species would attain to naturally at any time). The behaviour of *Lolium perenne* sown on good soils is an excellent example. Under these circumstances good seedlings of the commercial seed is economically justified, especially if hay is required in the early years of the ley.

c) The commercial seed may hasten the appearance of the desired plant and cause it to bulk somewhat more largely in the early years of a

ley than it otherwise would, but there is always some risk of the sown plant interfering with the development of the definitely lasting indigenous species. Good examples are *Poa trivialis* and *Cynosurus cristatus*. Knowledge of general conditions would often suggest excluding the former from a mixture, while the amount of seed of either that might be advantageously used needs further local investigation.

The desirability or otherwise of sowing the commercial seed of locally exotic species, or of but slightly secondary species, is easily determined. The commercial seeds lead to good results or they do not. If the commercial seed produces plants that are found to succeed it is however nearly always necessary to sow liberally; this is particularly true of *Dactylis glomerata*, *Festuca elatior*, *Cichorium Intybus*, *Phleum pratense* and *Arrhenatherum avenaceum*.

It is difficult to account for the spontaneous appearance of primary and secondary species (and of some locally exotic species, as *Holcus lanatus*, *Bromus mollis* et spp. and *Phleum pratense*,) on land long under the rotation when put down to grass, especially when more or less isolated from natural or semi-natural grasslands. The available evidence, however, suggests that:

a) Many species remain on the land as arable weeds on the so that suit them, as *Poa trivialis*, *Agrostis vulgaris*, *Festuca rubra* and *Rumex repens*.

b) The seeds of many species are probably introduced by the wind as *Holcus lanatus*, *Anthoxanthum odoratum*.

c) The seeds of many species are certainly introduced as impurities (useful and otherwise) in the sown seeds, as for example *Phleum pratense* (in *Trifolium hybridum*), *Plantago lanceolata* (in *Trifolium* spp.) *Holcus lanatus*, and *Bromus mollis* et spp. (in *Lolium* spp.)

d) There seems little doubt that the seeds of a great number of species are capable of lying dormant for long periods in the soil; in particular this may be true of *Trifolium repens* and *T. minus*, *Cynosurus cristatus*, *Poa* spp., *Phleum pratense* and *Festuca ovina*.

The data brought forward in this paper would seem further to justify the following broad generalisations with regard to both experimental work on grassland and the whole problem and economics of putting land down to grass.

1) Experimental plots dealing with seed mixtures should be laid out (at least half an acre) and square in order to give a considerable central zone. The hay should be cut as early as possible to avoid seeding and the carriage of seed from plot to plot. No series of plots can, henceforward, be regarded as complete without a control plot, which control should be seeded (with grasses and clovers) but left to the indigenous species to colonise. The control plot should, of course, be subjected to the same cultivations, receive the same manures, and grow the same nurse as the seeded plots.

2) Undoubtedly when putting land down to long duration grass as much or more can be done by making the habitat as suitable as possible

the desirable indigenous species as by including their commercial counterparts in the mixture. The commercial permanent grasses are far more valuable for say 4-6 year leys than they are for permanent grass as such.

Poa spp. and *Cynosurus cristatus* to some extent tide a field over its critical third and fourth years in proportion to the sowing, but in the later years the amount of the original seeding becomes of small significance compared to the influence of proper manuring and general management. Speaking generally pasture conditions favour the valuable indigenous species better than meadow conditions. On poor soils especially we are accumulating evidence to show that rape (folded on the land) is a much better nurse than oats or barley (removed from the field).

3) Our indigenous herbage plants offer a promising field for study. Or should modern investigators confine their attention to grasses and clovers only, with the exception of but a few miscellaneous herbs. The authors of the present paper have been struck in the course of their work by the extent to which such plants as *Juncus squarrosus*, *J. Gerardi*, *J. aciculatus*, *Bellis perennis*, and *Statice maritima*, are relished by stock.

It is, however, most desirable to study the locally successful varieties *Festuca ovina*, *Festuca rubra*, (with the other fine leaved fescues), *Poa trivialis*, *Poa pratensis*, *Lolium perenne*, and *Cynosurus cristatus*, with a view to estimating their relationship to the commercial counterparts and necessary with a view to establishing local supplies of the indigenous material.

The plants occurring in the district studied are given in classified lists of primary, secondary, locally secondary, locally exotic and exotic species.

A bibliography of 20 references is appended.

78 - Comparative Yields of Hay from Several Varieties and Strains of Alfalfa in South Dakota, U. S. A. — HUMM A. N. and CHAMPLIN M., in *South Dakota State College of Agriculture and Mechanic Arts, Agricultural Experiment Station, Bulletin No. 163*, pp. 282-243. Brookings, South Dakota, January 1916.

Various kinds of alfalfa were tested at the Stations at Brookings, Selmore, Eureka and Cottonwood from 1913 to 1915.

The following results were obtained from strains of *Medicago sativa*, tested on plots of one tenth acre in extent.

Strain	South Dakota number	Serial plant introduction number	Average yield per acre
			lbs.
.....	22	—	2 565
am	162	29 988	2 532
ceston	240	981	2 527

The yields given above are those of the first cutting only, as the second cutting was made after the alfalfa had seeded. The differences are too small to allow definite conclusions to be drawn as to the relative value of the three strains. Sometimes, however, Turkestan seed is unfavourably regarded on some of the Eastern markets, while the others meet with approval.

Strains of *Medicago falcata* were tested at Brookings from 1910-1915, with the results shown in the following table:

Strain	South Dakota number	Serial plant introduction number	Average yield per acre lbs.
Obb	42	20 452	2 865
Kharkow	47	20 717	2 046

These yields of hay were obtained from one cutting; usually *Medicago falcata* can only be cut once in a season, and consequently it does not give such good crops as strains of *Medicago sativa*, which always produce a second and even a third cutting.

The paper under discussion gives a very detailed history of the introduction of different kinds of alfalfa into South Dakota, with a full description of the various strains of *M. sativa* and *M. falcata*. Numerous strains of alfalfa seem to be natural hybrids between the two species, and on this assumption they have been named *Medicago media*. The strains of *M. media*, *M. ruthenica* and *M. platycarpa* which have been introduced into South Dakota are described.

1279 - **Silage from Green Forage in Java.** — **SCHMEL E.**, in *Teysmannia*, Year XX No. II. Batavia, 1915.

In many parts of Java there is a dearth of green forage during the season (east monsoon) and consequently the feeding of the livestock often very defective.

Attempts have been made in the Buitenzorg Gardens to make silage from a Bengal grass (*Panicum maximum*) which is often grown in Java. The silos consisted of holes dug in well drained soil, and were 3 feet deep and 6 feet across. Each was filled with 2860 lbs. fresh grass in full flower about three months old, care being taken to slightly raise the centre of the heap so that the rain should run off quickly. When the silos were the parts full they were covered with large stones and then with a layer of earth 16 inches thick to prevent any penetration of air. They were opened three months later and then contained acid silage of high quality which was much appreciated by the animals.

It was found that 50 per cent of the fresh grass was converted into useful silage after making allowance for loss of water and for the grass

which was spoiled by contact with the sand at the sides of the silo, 20 to 30 per cent of the nutritive constituents of the fresh grass were lost in the process of conversion into silage, except as regards fats and mineral substances. A mixture of equal parts of fresh forage and *Panicum maximum* silage is recommended for use in times of scarcity.

180 - **The Cohune Palm (*Attalea Cohune*) and its Products** (1). — MORRIS C. D., in *La Hacienda*, pp. 376-379. Buffalo, N. Y., September 1916.

CROPS YIELDING OILS, DYES AND TANNINS

The fruit of this palm contains a kernel which yields about 40 per cent of an oil that is said to be superior to coconut oil. It has been extracted for several years and has been used in place of ordinary burning oil. As a matter of fact this palm oil is suitable for other more important commercial uses. The Cohune grows in the region between South Mexico and Columbia and attains its best development in British Honduras, Guatemala and the Honduras Republic. In the latter country the soil of the forests is rich, marly, and of excellent quality. The trees grow about 5 yards apart and the fruits form enormous bunches which sometimes weigh as much as 165 lbs. each. The average yield of one tree is 1 000 nuts per annum, though some specimens will produce twice as many. By means of ether rather more than 40 per cent of oil can be extracted from the kernel; the cake contains 2.5 per cent of nitrogen and can be used as cattle food.

Cohune oil saponifies easily and furnishes an odourless soap which may prove to be useful in the manufacture of fine soap. The fibrous pericarp, which is about $\frac{1}{4}$ inch thick, also contains some fat. If factories are put up for the extraction of the oil from the kernels by means of solvents it might be worth while to extract the fats from the pericarps as well. When freed from fibre the fruit is 2-2 $\frac{1}{2}$ inches long and about 1 $\frac{1}{2}$ inches across. The shell is very hard and is about $\frac{1}{4}$ inch thick, while the kernel is as big as a large nutmeg.

In order to produce the oil on a large scale for export machines must be used to crack the stones. This is a very difficult problem to solve, as the machines must needs work with great force, with the result that the kernels are smashed as well as the shells.

This palm serves other useful purposes: houses are thatched with the leaves; the leaf stalks are woven with osiers and cord into fences and mats; the pith of the central stem can be used instead of cork for mounting insects; cord and hammocks are made from the fibres of the young leaves. The sap makes a refreshing drink, which is not so much used now as formerly.

(1) See also *B.* 1913, No. 1038.

RUBBER,
GUM AND RESIN
PLANTS.

1281 - **Hevea in Java.** — I. VRIENS J. G. C., *Planting and Thinning of Hevea*, in *Mededeelingen van den Adviseur der A. V. R. O. S. No. 4*, pp. 45-49. — II. SYET., *The Fall of Young Leaves in Hevea*. *Id.* pp. 59-60. Medan, 1916.

I. Various opinions are held as to the advantages of close planting of Hevea followed later by thinning out. The author puts forward the special advantage of this method in the upkeep of the plantations, and expresses his personal opinion that it is best to plant the trees 24×2 feet apart as a maximum and 19×18 feet as a minimum. The young plants should be very carefully selected from the nurseries.

The plantations must be kept well thinned in order that light can penetrate everywhere. Good drainage is essential and care must be taken that the water has free outlet. Pruning should be avoided and the plantations must be weeded every year.

II. The leaves of Hevea sometimes fall in the young stage. This defoliation always occurs after prolonged rains, and it is attributed to climatic causes, as no trace can be found of the presence of any cryptogamic disease.

1282 - **Some Experiments on the Coagulation of Hevea Latex without the Use of Acetic Acid.** — GERTER Dr. K. and SWART Dr. N. L., in *Mededeelingen van de Vereeniging Rubberproefstation West-Java No. 6*, Bandoeng, 1916.

The author gives as result of his investigations on the coagulation of Hevea latex the following summary:

1. If latex with an addition of 0.3 per cent of sugar is allowed to stand overnight, coagulation occurs by lactic acid fermentation, putrefaction being inhibited.
2. The so called slow coagulation of latex by means of small quantities of acetic acid (0.3 gr. per liter) is also caused by lactic acid from bacterial growth.
3. In order to get complete coagulation by the sugar process the addition of 20 to 25 per cent of water to the undiluted latex may be recommended, this quantity being diminished according to the concentration of the latex received in the factory.
4. On a factory scale the following proportions have been used;

175 L. latex, containing about 35 per cent of dry rubber.

50 L. of water.

400-450 gr. of sugar.

5 Under the above conditions the acidity of the serum after 48 hours has rather a constant value corresponding to 0.3 per cent of acetic acid.

6. The addition of serum of the former coagulation may sometimes be of use inhibiting putrefactive changes.

7. To prevent the formation of a coloured layer on the rubber it is advisable to pour water on its surface as soon as coagulation is setting in.

8. In laboratory experiments small quantities of bisulfite of soda had no disturbing influence upon the fermentation; on a large scale however the results hitherto have not been satisfactory.

9. The sugar process can only be used in preparing crêpe-rubber because of the porous state of the clot, gas bubbles being formed during fermentation.

10. Other coagulants have been discussed, chiefly in view of the preparation of sheet-rubber.

11. Thereby attention was drawn upon the dangers involved by use of coagulants such as sulfuric acid, *purub* and *aluin*.

12. The acidity of coconut water after fermentation did not exceed 5 per cent of acetic acid.

13. It was found that rubber prepared by the sugar process had same viscosity index as a control sample made by means of acetic acid on the same batch of latex.

14. The mechanical properties were found to be identical.

13 - **Studies in Indian Sugarcane, No. 2.** — BARBER C. A. (*Government Sugarcane Expert, Madras*), in *Memoirs of the Department of Agriculture in India* ("Sugarcane Seedlings, including some Correlations between Morphological Characters and Sucrose in the Juice") *Botanical Series*, Vol. VIII, No. 3, pp. 103-198. Plates I-XXIX and numerous tables. Calcutta, July 1916.

SUGAR CROPS

The present contribution to the study of sugarcane seedlings in India divided into 4 sections. The first of these deals with the material available and contains an enumeration of the seedlings thus far raised, with notes as to the chief difficulties encountered and the means by which these have been overcome. The second discusses the differences noted in the useful characters of the seedlings before planting out and at maturity. The next section treats of the mode of analyses adopted and the variations in the juice of the seedlings as regard sucrose content, and the last summarises the correlations thus far studied between the characters of mature seedlings and the amount of sucrose in the juice.

The experiments were conducted at the Government Cane Breeding Station at Coimbatore in the Madras Presidency with a certain amount of preliminary work at the Botanical Garden attached to the local Agricultural College.

I. — **ENUMERATION OF THE SEEDLINGS RAISED.** — The failure of previous sporadic attempts at raising cane seedlings in India is probably due to the fact that fertilization was not properly effected owing to the immature state of the pollen used. A detailed study of cane inflorescences has shown that the pollen is only fully developed where the anther locules have dehisced. It has been found that if the anthers do not open when the flowers mature they remain closed permanently; it is therefore clear that the first essential in raising canes from seed is that only flowers should be used in which the anthers dehisce.

The sugarcane commences to flower at Coimbatore in October and most of the seedlings are obtained during the following 2 months. They are planted out in the field when about 6 months old and are ready for harvesting and analysis after another 12 or 18 months from sowing. In this way the seedlings obtained during any particular season are designated by the years of sowing and of chemical analyses.

TABLE I. — *Vitality of Sugarcane Seed.*

Variety	Date of collection	Germination	February 1	March 1	April 1	June 1	July 1	August 1	Remarks
Madras No 2 . . .	9th Dec. 1914	500	500	300	200	100	20	0	Equal quantities of prepared arrow were in the first five months. The seed remained on germination for 1 months. The are Saretha survived longest and that B 208 had least vitality.
Madras No 6 . . .	15th Dec. 1914	500	500	300	200	100	20	0	
Saretha	14th Dec. 1914	500	500	500	300	200	40	0	
Java	4th Jan. 1915	500	500	300	100 Less than 100	50	0	0	
B. 208	5th Jan. 1915	500	500	300	100	12	5	0	A less quantity of as sown.
Striped Mauritius Do		200	200	100	50	12	0	0	

During the periods 1911-13, 1912-14, 1913-15, 1914-1916, several thousands of seedlings were raised from seed derived from local varieties or from arrows collected from various parts of India. The data relating to the seedlings — parentage (whether selfed or crossed), percentage of open arrows, germination etc. — are collected, in a series of tables. In the present summary space only allows of attention being paid to points, of more general interest. For instance, in 1914, owing to the somewhat saline nature of the soil of the experimental plots and to the quality of the irrigation water, some interesting data were obtained as to the great variation in the capacity of different canes to resist saline soil and water, some growing strongly and thickly while others die out completely.

The study of the cause of arrowing in the cane has led to fruitful results. There are 2 cane-planting seasons in the neighbourhood of Coimbatore, one in February-March and one in July-August or even later. The former is in vogue on garden-land irrigated by wells and the latter on wet lands and tanks. From a special study of each field from which arrows were obtained in the neighbourhood it soon became evident that canes planted in February-March do not usually flower while those planted at any time between August-Nov. do so in the following Oct.-Nov. if allowed to remain in the ground. In the wet land generally the canes are more likely to flower and this has been found to be the case even when they are planted as early as April-May. The result of an experimental arrowing plot under these latter conditions was eminently satisfactory. Among others, some 12 North India canes bore arrows, some for the first time on record. Unfortunately, in most of these the stamens remained obstinately closed but it is hoped to overcome this drawback by crossing a hardly North Indian indigenous cane with a rich exotic one provided they can be induced to flower simultaneously.

During the last period, 1914-1916, experiments were carried out on

vitality of cane seed. The results, as shown in the appended table I are interesting as it is evident that, with proper care, cane seed retains its vitality for a considerable period.

II. — VARIATION IN MORPHOLOGICAL CHARACTERS. — Under this heading are considered variations in vigour and size, general habit, erectness of young shoots, tillering, width and colour of leaves, colour and thickness of canes. Between some of these characters a certain amount of correlation is observed which, though not definitely settled, at least gives the impression that further study will show that certain infantile characters of the seedlings will be found to be related. If this can be proved, a great step in advance will be made as all present indications point to the fact that any classification of the cultivated sugarcane must be based on the accumulation of a number of often, very minute morphological characters, which, taken together, give the plant an indefinable but real mode of habit. With regard to vigour and size the seedlings of any batch though raised under identical conditions differ greatly in size and vigour. In many cases it has been noted that seedlings standing out from the rest because of their great growth, have a comparatively low sucrose percentage in the juice. Excessive vigour in a seedling, otherwise than a cross, is therefore not altogether a desirable character.

III. — VARIATION IN THE SUCROSE PERCENTAGE IN THE JUICE. — In addition to the usual "bulk" analyses of the juice at harvest time, a series of preliminary ("petty") analyses were made before that date as the seedling of different parentage vary very considerably in their order of ripening and the petty analyses give an idea as to the order in which the plots should be cut for final analysis.

Later on, as the bulk analysis at crop time was not considered a sufficiently safe guide, it was decided to select from the series of analyses of any seedling, that containing the highest reading of sucrose. In doing this, however, due regard was paid to the percentage of glucose and the botanical description made at crop time.

The accompanying table II giving details of the amount of sucrose in the juice of parents and seedlings shows considerable variations in the sucrose content of seedlings of the same parentage. There is also a definite relation between parent and offspring in this respect, the better parents producing the better seedlings. The analyses of the special crosses also show that the sucrose in the seedlings approximates to the average of the two parents. In other cases the average sucrose of the seedlings is generally lower than that of the parents but this may be due to the fact that it was not always possible to analyse a seedling at its optimum.

Table III shows the effect of different soil and environmental conditions on the quality of the juice of seedlings. It will be seen that the seedlings respond readily to changes in soil and water.

The question as to the permanence of the juice characters of cane seedlings when propagated as sets has been studied but the data are as yet insufficient for definite conclusions to be drawn. Both the period of the year at which canes are cropped and the nature of the weather appear to influence

TABLE II. — Comparison of sucrose in the juice in parents and seedlings, 1912-14.

Parents				Seedlings			
Number of analyses	Locality	Range of sucrose %	Average sucrose %	Number of seedlings analysed	Locality	Range of sucrose %	Average sucrose %
5	Cane Breeding Station do.	15-18	16.67	500	Cane Breeding Station	8-21	14.7
3	do.	15-18	16.02	345	do.	10-20	14.7
4	do.	14-20	16.78	60	do.	10-17	13.8
5	Aligarh Farm 1913	13-17	14.59	51	do.	1-18	14.6
15	Cane Breeding Station	11-17	13.83				
4	Wet Lands Coimbatore Central Farm	18-19	18.91				
12	Cane Breeding Station	11-14	12.67	19	Botanic Garden, Coimbatore 1913	9-15	12.2
5	Wet Lands Coimbatore Central Farm	18	17.67	16	Cane Breeding Station 1914		
10	Mysore	16-19	17.01	17	do.		
5	Cane Breeding Station	13-17	14.61	180	do.	5-17	15.2
12	do.	9-16	12.36				
3	Wet Lands Coimbatore Central Farm	15-17	16.37				
9	Cane Breeding Station	12-16	13.81	18	do.	6-12	9.0
7	Wet Lands Coimbatore Central Farm	16-18	17.30				
—	North India	14-15	14.78				
7	Cane Breeding Station	3-5	4.00	81	do.	6-13	9.8
5	do.	9-16	12.94				
4	Sabour Farm Taylor 1911	17	16.04				
—	Cane Breeding Station	3-5	4.00				

The effect of seedlings grown under different conditions (all bulk analyses).

Seedling and its percentage	Garden Land at Coimbatore (well irrigated)										Wet land in Central Farm Coimbatore tank irrigated 1915	Adriatic Farm Coimbatore Jatbulpore 1914-1915
	Botanic Garden 1913 ¹		Cane Breeding Station A 1914		Cane Breeding Station B 1914		Cane Breeding Station B 1913		Wet land in Central Farm Coimbatore tank irrigated 1915			
	Sucrose	Glucose	Sucrose	Glucose	Sucrose	Glucose	Sucrose	Glucose	Sucrose	Glucose		
Madras No 2 (Kaludai Boothan).	11.55 %	1.53 %	10.24 %	0.71 %	13.18 %	0.52 %	12.21 %	1.11 %	14.58 %	0.67 %	15.21 %	1.24 %
Madras No 6 (Poovan)	11.88	1.45	7.95	1.32	9.60	0.94	9.34	1.43	13.83	0.48	13.04	1.60
Madras No 11 (Poovan)	12.40	0.92	Failed		13.64	0.65	16.09	1.10	17.26	1.00	—	—
Madras No 19 (Cheni)	11.43	0.22	12.89	0.86	12.64	0.65	13.26	0.48	16.75	0.10	12.74	1.12
Madras No 21 (Cheni)	12.36	0.16	Failed		12.50	0.17	15.07	0.52	18.20	0.30	14.49	1.02
Madras No 25 (Cheni)	14.68	0.10	11.86	0.51	12.56	0.56	13.96	0.81	15.72	0.33	14.63	0.90
Madras No 29 (Cheni)	15.33	0.10	9.79	0.38	13.61	0.30	15.55	0.17	17.32	0.10	—	—
Madras No 45 (Cheni)	10.05	0.17	10.83	0.61	15.81	0.65	11.74 *	0.67	17.78	0.29	14.71	1.02
Average	12.31 %	0.58 %	10.59 %	0.73 %	12.95 %	0.55 %	13.40 %	0.79 %	16.43 %	0.41 %	13.13 %	1.15 %
Average of five regions at all places	11.94 %	0.69 %	10.75 %	0.80 %	12.76 %	0.66 %	12.10 %	0.90 %	15.73 %	0.37 %	14.07 %	1.18 %

¹ First year seedlings grown in large pits filled with good soil but irrigated with brackish water.

In second year seedlings were raised in pits filled with good soil but irrigated with brackish water.

A — Set plants grown first year from seedlings — in small pits filled with good soil, earth around saline; and irrigated at any rate at first with brackish water.

In 100,000 parts of water: — Total solids 312, injurious salts 249, sodium chloride 165, sodium chloride 127.

B — Set plants grown first and second year from seedlings — in small pits filled with good soil; earth around slightly saline; irrigated with sweet water.

In 100,000 parts of water: — Total solids 312, injurious salts 55, sodium chloride 33.

* 14.82 in party analyses, therefore probably over ripe.

considerably the character of the juice. Extraordinary variations have been met with in a seedling in analysing the different canes in the clump. This has led to increased care in sampling and the discovery that certain varieties produce, in a given clump, two kinds of cane, differing both in certain morphological characters and in time of origin. In analysing the juice of canes this classification into early and late varieties cannot be ignored.

Taking the whole series of *selected* seedlings during the last 3 seasons, it is seen that the sucrose content in the seedlings has risen continuously as follows :

TABLE IV. — *Sucrose in the Juice of Selected Seedling.*

	Number of seed- lings grown	Over 17 %	Over 18 %	Over 19 %	Over 20 %	Over 21 %	Over 22 %	Over 23 %	Remarks
1911-1913 (over 17 %)	48	2	—	—	—	—	—	—	All the seedlings were grown
1912-1914 (over 17 %)	2,068	95	40	9	2	—	—	—	The standard of selection, 17% sucrose in the juice and over
1913-1915 (over 18 %)	2,400	400	138	104	22	3	1	1	The standard of selection, 18% sucrose in the juice and over together with vigorous growth

IV. CORRELATION BETWEEN MORPHOLOGICAL CHARACTERS OF SEEDLINGS AND RICHNESS OF THEIR JUICE. — The advantages that would accrue, as regards economy of time and trouble, from the discovery of correlations between morphological characters of the young seedlings with richness in juice are obvious; but there are special difficulties in the way and the principle has been adopted of trying first to find such correlations in mature canes at crop time and later to attempt to correlate infant and mature characters. The first step alone has been tried at present and the following correlations have been studied between mature characters and sucrose in the juice, the results being summarised in table V appended: — correlation between the amount of sucrose in the juice and various leaf and cane measurements (width, length and module, or length divided by width) and colour of cane, and correlations between leaf width and thickness of cane, tillering power and total weight of seedling.

TABLE V. — Summary of Correlations.

	Cuttan	Karun	Kahulal Boothan	Sarethia	Cheni	Proovan	Naanal	Shakar Chytia X Sacharum	Vallal X Sacharum	Notes
Number of seedlings dealt with	477	323	54	46	18	13	65	71	80	
Leaf width and sucrose	—	—	—	—	—	+	+	+	+	(1) The numbers are so few that a single seedling has turned the scale.
Leaf length and sucrose	—	—	—	—	—	—	—	—	—	
Leaf module and sucrose	+	+	+	+	+	0	—	—	—	
Cane thickness and sucrose	0	—	—	—	—	+	—	+	+	(2) In 10 out of 16 cases where 4 classes were possible, the curve is quite distinct and peculiar. There is a steady rise in thickness in the first three classes, followed by a fall in the fourth. In 4 of the remaining 6, the third class still has the highest sucrose (cf. p. 159).
Cane length and sucrose	+	+	+	+	+	0	0	0	+	(3) In Naanal and Shakarchyia X Sacharum <i>spondanum</i> , the curves are similar, there being a rise from the first to the second class, followed by a fall from the second to the fourth (cf. p. 159).
Cane module and sucrose	+	+	—	+	+	+	—	—	+	
Leaf width and thickness of stem	+	+	+	+	+	0	0	0	+	(4) In Naanal and Shakarchyia X Sacharum <i>spondanum</i> , the first and fourth classes are much the largest and the second and third considerably lower (cf. p. 166).
Leaf width and total weight	+	+	+	+	+	+	+	+	+	
Leaf width and tillering	—	—	0	+	—	+	—	—	—	

STIMULANT,
AROMATIC,
NARCOTIC
AND MEDICINAL
PLANTS

- 1284 - *Coffea* in Java. — I. CRAMER P. J. S. *Coffea excelsa* in Java, in *Teysmannia*, Year XXVII, Nos. 4 and 5, pp. 211-223. Batavia, 1916. — II. KEUCHENIUS P. E. Notes on the Fertilization of *Coffea excelsa* in Java, in *Mededeelingen van het Besoekisch Proefstation*, No. 20. Surabaya, 1915.

I. *Coffea excelsa* was discovered in the Congo in 1904 by A. CHEVALIER, and it was introduced into Java through the State Agricultural Station, which received some seeds from the Colonial Garden at Nogent-sur Marne (France) It resembles *Coffea liberica*, from which it is distinguished by some secondary characters, especially by the smaller fruits. The berry has a soft watery pulp and a tender skin which is easily removed.

Various types of plants were raised from the first seeds introduced into Java and careful selection will be necessary to obtain a good stock for cultivation. During the extraordinary and prolonged droughts of the last few years *Coffea excelsa* has shown greater powers of resistance than other species of coffee.

Investigations on selection and on the best methods of cultivation are being carried out at the State Experimental Station.

II. Observations have been made on the different ways in which coffee is pollinated, as insects are almost entirely absent from the plantations. The relative positions of the stamens and pistil in the flower makes self-pollination very difficult. The pollen is easily shaken down on lower flowers, and it is also carried by the wind. It is therefore probable that self fertilization is very rare, and that most flowers are cross-fertilized.

- 1285 - *New Method of Detecting Adulteration in Tea.* — REHFUS L., in *Bulletin de la Société botanique de Genève*, 2nd Series, Vol. VIII, Nos. 1, 2 and 3, pp. 24-28. Geneva, January, February and March, 1916.

The method is based on examination of the stomates, which are quite different in *Thea sinensis* from those in any of the other leaves used for adulteration. In the stomates of *Thea* the guard cells possess, on their inner surface, a very strongly marked layer of cutin which is prolonged into a beak or hook, and which is distinct from the beak which closes the ostiole.

Various kinds of tea have been examined. The stomates of Pecco tea are strongly cuticularised and possess the characteristic hooks. Ceylon tea is made from rather young leaves in which few of the stomates are fully developed; the cutin is less marked but the hooks are plainly visible although they are not very well defined. Both characters are also evident in Java tea, black tea (Souchong), Imperial, Congo, Russian tea from West Caucasus, Shangai green tea, Chinese yellow tea, green tea from South Mongolia. The same characters appear even in the sepals of *Thea sinensis*.

The only leaf used for adulteration that bears much resemblance to that of *Thea* is the *Camelia* leaf. A transverse section of one of the latter leaves shows that the stomates are quite different from those of *Thea*, for though they are strongly cuticularised the hooks are but very slightly developed.

286 - Investigations about the Dying out of Peppervines in the Dutch East Indies. —
 II Pepper-cultivation in Banka. — RUTGERS A. A. L., in *Mededeelingen van het
 Laboratorium voor Plantenziekten* No 19, with illustrations. Batavia, 1916.

SUMMARY

I. Pepper was introduced in Banka about 40 years ago by Chinese from Riouw. Since 20 years the Bankanese (Malay natives in Banka) have been planting pepper, imitating the Chinese. The export from Banka amounted in 1913 to 2 ½ million *guilders* (over £ 200.000).

II. Pepper-cultivation in the Dutch East Indies has two distinct forms: on the one hand the cultivation, as practised since many centuries by the Malay in Sumatra, a form of agriculture based on exhausting the virgin soil and leaving it alone afterwards, on the other hand the cultivation, as practised by the Chinese a refined form of horticulture. The pepper cultivation in Banka is of the latter type.

III. The pepper-cultivation by the Chinese in Banka is marked by the following characteristics:

A. The pepper is grown at dead stakes without shadow.

B. By careful tillage; big plant holes, big burying-trenches and the use of first rate cuttings for planting vines are grown with an extensive and vigorous root system.

C. The pepper vines continue producing 20 or even 30 years as a result of careful cultivation and abundant manuring with "burnt earth", il-cakes, cattle manure, fish manure etc.

D. The average production of each vine amounts to 3 kattie (= 4 lbs.) white pepper a year.

IV. The pepper cultivation by the Bankanese is a cheap imitation of the cultivation by the Chinese. Tillage, burying of the young vines and manuring are usually neglected. The vines are dying out within 9 years; the production of each vine is less than 1 kattie (= 1.3 lbs.) white pepper a year.

V. The following diseases and pests have been found in Banka:

A. Prematurely dying out as a result of planting in unsuitable soil.

B. Prematurely dying out as a result of insufficient care.

C. The leaves are eaten by a beetle (*Holotrichia spec.*)

D. The stems are eaten by termites.

E. The fruits are damaged by a small weevil, which eats small holes in the unripe seed.

F. On the leaves lice have been found.

G. Larvae have been found boring in the branches.

H. A cobweb fungus has been found on the leaves.

VI. The peppervines of the Bankanese show a marked difference from those of the Chinese: the last-named ones produce 4 lbs. white pepper a year during 20 years, the first-named ones three times less during one third that time.

There is no other reason for this difference than the careful cultivation

by the Chinese and the neglecting of several necessary measures by the Bankanese. Which of the measures of the Chinese is the most important cannot be stated theoretically. Only experiments especially arranged for this purpose can settle this point.

1287 - Notes on the Extraction of Citronella Oil. — JONG A. W. K., in *Teysmannia*, Year XXVII, Nos. 4 and 5, pp. 246-252, Batavia, 1916.

Experiments have been made which show that the drying of citronella leaves (*Andropogon Nardus*) before distillation gives good results. Drying in the sun must be avoided, as this causes a rather heavy loss of essential oil.

Leaves that have been cut into pieces from 3 to 5 cm. square are more easily extracted than entire leaves. In the process of distillation care must be taken not to use any un-tinned metal tubes, as lead and copper form sulphates which discolour the oil.

1288 - Tobacco Growing in the Illyrian Region. — BALDACCI A., in *Ministerio delle Finanze, Direzione generale delle Privative, Bollettino tecnico della Coltivazione dei Tabacchi pubblicato per cura del R. Istituto Sperimentale in Scafati (Salerno)*, Year XV, Nos. 1 and 2, pp. 3-28. Scafati, January-February and March-April 1916.

Dalmatia. — Tobacco growing has been carried on in the Illyrian region for some centuries, and after the annexion of Dalmatia to Austria it became a monopoly. The Austrian Government then experimented with Herzegovinian tobacco and obtained good results by selection. Afterwards a long series of investigations were made with Macedonian tobacco and later still with American types. In 1863 Trebinyan tobacco was acknowledged as the best, and the other types were gradually given up.

When cigarette smoking came into fashion experiments were begun (1884) to improve the cigarette tobacco. These trials were carried on in Southern Dalmatia, as this was the only country in Austria-Hungary which produced this type of tobacco. Herzegovinian (Trebesat and Megiugorge) and Turkish (Giubek-Yakà, Kir-Yakà, Porsician, etc.) types were tested; Sumatra types were also tried, but were quickly abandoned as they gave such poor results. During the next twenty years the Dalmatian hybrids deteriorated more and more rapidly on account of imperfect selection, so fresh improvements were made. The best results were obtained by crossing Macedonian and Herzegovinian tobaccos. This method however, brought two difficulties in its train:

1) A great lack of uniformity in the crops was caused by the intercrossing which occurred owing to the presence of so many different varieties in the country.

2) The climatic and soil conditions caused the plants to revert to the wild type.

The Government was thus compelled to attempt fresh improvements:

- 1) To raise good hybrids adapted to the climate and soil of the different localities;
- 2) To fix and acclimatize the hybrids;

3) To obtain uniformity of crop by means of a suitable choice of seed;

4) To establish government institutes for the production and control of tobacco seed.

In 1904 experiments were begun at Imoski and artificial crosses were made between Herzegovinian types (Stolatz and Drinovtzi) and Macedonian tobaccos (Kir and Giubek), the first crop from original seed being set for parents. The following crosses were made:

Drinovtzi × Giubek	Giubek × Drinovtzi
Drinovtzi × Giubek	Giubek × Drinovtzi
Drinovtzi × Kir	Giubek × Stolatz
Stolatz × Giubek	Kir × Drinovtzi
Stolatz × Kir	Kir × Stolatz.

The resulting hybrids were grown in 1905, and the descendants of the cross between Drinovtzi and Kir were much better than their parents. These hybrids were again crossed with one of the parents, thus:

Drinovtzi × Giubek ¹	Stolatz × Giubek ²
Drinovtzi × Kir ²	Stolatz × Kir ²

After 1909 the trials were more and more improved by the use of SCHELONI's method. It had been proved that the distance between the plants has a very great influence on their character and qualities, so that the more the distance between the rows and between the plants in the rows was reduced the more closely did the hybrids in the plantations approach the Macedonian type in character.

After 1908 the American method of race improvement by artificial self-fertilization was also practised on Giubek.

The chief facts established by the Imoski and Sinj trials are as follows:

When Herzegovinian tobacco is crossed with a Macedonian type the hybrids in the first two generations almost equal the taller parent in height, but in the later generations the height decreases, at first rapidly, then more slowly; the number of leaves behaves in the same way as the height. The maximum length and breadth of the leaves, after the first cross, rapidly and constantly decrease, and may throw back to that of the taller of the parents; the ratio, length: breadth, of the leaves increases in the first and approaches, but never quite equals, the ratio of the Macedonian parent.

When a Macedonian tobacco is crossed with a Herzegovinian type the number of the leaves and the height of the hybrids decrease steadily in the first generation; the length and breadth of the leaves increase gradually; the ratio, length: breadth, decreases from the beginning and approaches, but never quite equals, that of the Herzegovinian parent.

Similar regular gradations can be proved with regard to length of pedicels, number of flowers, the arrangement of the inflorescence, size and angles of insertion and the strength of the leaf venation.

In a series of hybrids the nicotine content increases with the Macedonian element and decreases with the increase of the Herzegovinian element; the first crosses behave in different ways according to the particular combination of parents, so that no general rule can be laid down.

Albania. — Tobacco can be grown in all the regions of the lower plain (Scutari basin, Musakia plain, Diakova and Prisrend basin, plains of the great Albanian lakes, valleys of Argyro-Kastro, Janina and Iapista) but the crop is of little importance in the country. While Albania might have been a great tobacco market she occupies, in regard to this crop, the lowest place among the provinces which were formerly included in Turkey in Europe: her production rarely covers her consumption.

Tobacco growing was taken over by the Turkish Government in 1878, at the time when the vilayets of Epire and Monastir and the Durazzo Sanjak (vilayet of Scutari) were under Turkish rule.

The Albanian tobacco now closely resembles the Montenegrin type in character; it was derived from Herzegovinian types by the old method of crossing. If the plants are grown very far apart the leaves sometimes develop enormously with very pronounced ribs; in spite of this the texture is usually rather fine for such a large leaf. The dominant colour is generally light maroon, more rarely yellow; the upper leaves ripen with difficulty, because the plants lose their flowers too soon. Even the best samples, such as those from the Scutari province, are too strong for cigarette tobacco and have little aroma. Possibly the lack of flavour may be due to defective methods of preparation, but this can be remedied by suitable mixing.

The tobacco seeds are sown in February and transplanting begins in April; one to three weedings are given, one being the most usual number. Harvesting starts in August, and the leaves are threaded on strings, which are taken under cover as soon as damp weather sets in. No trouble is taken to select uniform leaves, and the strings are made up of all qualities and colours. After harvesting, the leaves are sold to manufacturers who turn them into fine pipe and cigarette tobaccos. All the work is carried out by hand labour.

Considering the economic condition of Albania it is doubtless advisable to suggest the continued growing of the yellow Herzegovinian types, which are suited to the soil and which have been improved by cross breeding carried out by the Austrian Government in Dalmatia and by the Italian Government in the Lecce province. Tobaccos of this type are easily acclimatized in warm and dry soils, they do not need stopping nor special cultivation, they can be dried in the open air in the sun (they do not even need special places for treatment) and they need little hand labour in manipulation for market.

The growing of Giant Herzegovina might be tried in the Albanian region. The Scafati station obtained the original seeds from Dalmatia, and by careful selection very large plants have been raised, with 50 to 70 leaves on a stem, 3 or 4 times as many as in ordinary Herzegovina. At the present time the variety is grown on a large scale in the Lecce province, where it

fields from 2 570 to 2 646 lbs. of leaves per acre. The only fault of this plant is that the topmost leaves are lost because they ripen very late. It is very probable that Giant Herzegovina corresponds to the Austrian Gradatz which was apparently obtained it in 1908 in the Sinj Experimental Station by natural crossing probably with a Turkish tobacco. This vigorous type might be used in Albania as a basis for hybridization. Besides this, recourse might be had in Albania (as has already been done in Montenegro) to the growing of certain Macedonian types belonging both to the Bashi-Bagli group with stalked leaves and to the Basna group with sessile leaves. It would be necessary to restrict these to districts where the growers were willing and able to manipulate the produce carefully.

Without doubt Porsician, which is a good Bashi-Bagli, should be tried first, as it has given good results in the Lecce province, and it is occasionally met with in very restricted areas in Central Albania. Other types might then be tried, including Zinha, Mahala, Tdyrnegik, Kirs, Xeres, Kara-Suluk, Samsun etc. besides many other varieties of tobacco, from temperate or subtropical zones, differing in type from the Herzegovina and Macedonian tobaccos, such as Maryland, Burley, Italia \times Kentucky, etc. On the other hand tropical types of tobacco such as Sumatra, Java, Havana, Saint Dominique, and Bresil, do not succeed in Albania because they are not suited to the climate of this region.

3 - New Varieties of Italian Tobacco, Resistant to *Thielavia basicola* (1). — BENINCASA M., in *Ministero delle Finanze, Direzione Generale delle Privatizze, Bollettino Tecnico della Coltivazione dei Tabacchi pubblicato per cura del R. Istituto sperimentale in Scafati (Salerno)*, Year XV, Nos. 1, 2, pp. 29-33. Scafati, January-February and March-April, 1916.

In an earlier article (*Bollettino Tecnico del R. Istituto sperimentale di Scafati*, No. 5, 1914) the writer described some experiments which showed that the decline in the growing of Kentucky tobacco in some parts of Italy is due to root rot, and, as all other remedies proved useless, the planting of special resistant varieties was advised. In the present paper the best methods of growing these new varieties are discussed, and attention is drawn to their industrial characters and to the impetus that has been given to tobacco growing in the districts where they have become established. These varieties are chiefly hybrids and in addition to being resistant to *Thielavia basicola* they have other advantages from the growers' standpoint and they possess valuable commercial qualities. As these varieties are becoming more and more local in character they may be grouped according to the districts in which they are chiefly grown, as follows:

Hybrids of Cava dei Tirreni. — Numerous hybrids of heavy tobacco have been tested in this locality during the last few years, and Italia Kentucky and Salento \times Kentucky have become established. According to Dr. ANGELONI, since Italia is a hybrid between Kentucky and Sumatra, Italia \times Kentucky possesses the hereditary character-

1) See also B. 1912, No. 234.

istics of Kentucky and Sumatra in the proportion 3:1. This variety earlier and develops more quickly than Kentucky and it is much more resistant to root rot.

The tobacco is finer and lighter, with a stronger smell. It likes a fertile and open soil, and a rather warm climate. In localities other than Cava de Tirreni it has not always proved successful.

Salento is a hybrid between Kentucky and Cattaro, so that Salento \times Kentucky possesses the hereditary characteristics of Kentucky and Cattaro in the proportion of 3:1 and is more resistant to root rot than Kentucky. It is earlier and develops more quickly and also it is less exacting as regards soil and climate. But, like Italia \times Kentucky, it is subject to rust after the first cold dews, especially when ripening is very late, that it is not advisable to plant this variety in places where tobacco is attacked by oidium. It is more productive than Kentucky but is less valuable for commercial purposes.

When Italia \times Kentucky is crossed with Salento \times Kentucky the resulting strain (which is not yet properly fixed) combines the good qualities of each of the parent hybrids and eliminates their defects. It sees that repeated crossing of tobacco renews its vitality and increases its vigour of growth.

The introduction of hybrids into Cava de Tirreni has not only checked the decline in the growing of Kentucky tobacco but it has increased the yield per acre about 20 per cent. In addition to this less labour is needed as the young plants root more easily.

Pontecorvo hybrids. — For several years the damage caused by root rot at Pontecorvo was remedied by the planting of Salento \times Italia, but at the present time this hybrid is being gradually replaced by Moro \times Kentucky.

Salento \times Italia from the phylogenetic standpoint possesses the characteristics of Kentucky, Cattaro and Sumatra in the proportion 2:1 and it is one of the varieties that are the most resistant to *Thielavia*. It is early, hardy, and very accommodating as to climate and soil, but is easily damaged by the wind as it has only a few spreading and fragile leaves that it is not recommended for distribution.

Moro \times 3 Kentucky possess characteristics of Kentucky and Moro Corvi in the proportion of 7:1. Botanically it differs little from Kentucky but it is earlier and is sufficiently resistant to *Thielavia* to pass safely through the critical period of rooting when planted out. On the whole this may be called an improved Kentucky.

In order to increase the resistance of Moro \times 3 Kentucky and the Salento \times Italia these two hybrids have been crossed with one another for two seasons, with very promising results.

Salento in the Benevento region. — Salento is a hybrid between Kentucky and Cattaro raised about 1900 at the Scafati Institute in order to obtain a low priced pipe and cigarette tobacco, and for several years it was grown for that purpose only in the region of Lecce and other parts of Italy. In 1911 experiments were made in the Benevento Gardens to remedy the troubles

caused by the wholesale loss of the young plants of the variety Burley, which was grown there at that time, and Salento was more successful than any of the other Italian hybrids. Salento shows the characters of both its parents. It is very vigorous, fairly early, and very adaptable as to soil and climate, it stands drought well, is very resistant to *Thielavia*, and is hardly at all susceptible to rust and *oidium*. Commercially it is inferior to Kentucky, chiefly on account of its percentage of large veins, but, under the conditions in which it is grown in the Benevento region it becomes much finer and resembles Seedleaf rather than Kentucky. In the Italian industry it has no equal as a substitute for Kentucky.

The average production of the Benevento Gardens was 1319 lbs. per acre when Br sil tobacco was grown; the yield fell to 1167 lbs. with Kentucky and to 972 lbs. with Burley; in 1914 it rose to 2050 lbs. with Salento.

As cigar tobacco Salento is only grown in the region of Benevento; when it is planted elsewhere it easily loses its fine qualities.

To sum up, several new Italian varieties have been produced which are more or less resistant to root rot. The chief characters of these new varieties are as follows:

- 1) Most of them resemble Kentucky in their botanical and commercial characters but they are more resistant to *Thielavia*.
- 2) The less closely the hybrid resembles its parent Kentucky the further removed is the product from the heavy type of tobacco. The first character to disappear is the compactness of the tissues, a quality which seems to be determined more by the environment than by anything else. In the Italian Kentucky the tissue is less compact than it was in the original Kentucky.
- 3) In spite of the lighter weight of the tissue the parent Cattaro considerably raises the yield, so that under normal conditions the hybrids of Cattaro are more productive than Kentucky, while all the others are less productive.
- 4) In addition to being more resistant to root rot the new varieties, earlier, they develop more rapidly and can stand drought better; they are hardier and at the same time better adapted to the Italian climate. These qualities tend to become strengthened by repeated crossings.
- 5) New varieties of similar characters and constitution tend to become localised in distribution.

The introduction of these hybrids has had a considerable influence on the production of the Kentucky type of tobacco in the three zones mentioned. In an appendix, the yield of the hybrids is compared with that of pure Kentucky.

-Experiments on Tobacco Fermentation in Java. — DR. VRIES O., in *Mededeelingen van het Proefstation voor Vorstendlandsche Tabak*, No. XXI, Samarang, 1915.

A plant has been invented to exhaust the air from the interior of fermenting stacks of tobacco, and the results obtained are described in the present paper. The apparatus consists of rings of perforated iron tubing which are placed at different heights in the stack and which are connected

with an air pump by means of tubes. Stopcocks regulate the suction in the various tubes, and the temperatures in the different parts of a stack are registered by electro-thermometers. The object is to keep the temperature constant at a pre-determined point, as if this could be maintained for a certain time it would do away with the inconvenience of remaking the stack when the tobacco heats too much, a process which greatly increases the percentage of broken leaves.

This plant has been improved during the last year and has given good results with hands of tobacco placed in the middle of the stacks, while the rise in temperature can now be checked at any desired point. Unfortunately after the temperature has been lowered, the cooling process continues and cannot be stopped. The hands placed towards the outside of the stack cannot derive any benefit from the aspiration of the air, and consequently the stack must be remade for their benefit. It is hoped that better results will be obtained by covering the stack with isolating material.

A large thermostat has been devised for regulating the rise and fall of temperature during fermentation, but the experiments so far have not yet given any positive results. Special tests have shown that during the first few days the lower layers of a stack heat up most, whereas later on the hands placed in the middle of the stack reach a rather higher temperature than those lower down.

Other experiments have shown that if the stacks are made too large and if moist tobacco is used they may overheat badly, resulting in serious deterioration in the tobacco, even if the overheating does not cause the stacks to catch fire.

FRUIT
GROWING

1291 - **The Fruiting of Trees in Consecutive Seasons.** — PICKERING S., in *Journal of Agricultural Science*, Vol. VIII, Part I, pp. 131-135. Cambridge, September 1916.

Points of considerable interest, both scientific and practical, are raised by the question as to whether a tree which fruits exceptionally well compared with its fellows in one season, will tend to fruit exceptionally well, or the reverse, in the following season. We know of no definite reason why the behaviour of a tree as regards fruiting should alternate in consecutive years, and no such behaviour has been observed in the case of mammals. Its doing so would imply that fruiting is due to the gradual accumulation of some substance in the tree, which becomes exhausted when heavy bearing occurs, and that the stock of this substance does not become properly replenished till after another season has elapsed.

The difficulties in obtaining exact measurements of the relative behaviour of any two or more trees in consecutive seasons are considerable. The weight of fruit or the number of fruits may be recorded, but, unless the trees are absolutely similar in size, disposition of branches, situation, etc., which is impossible, the superiority of the one over the other as regards inherent fruiting capabilities may be misleading. On the other hand, trees under observation may be classified by inspection, grouping them according to the extent which they are loaded with fruit, independently of their size, and then comparing the classification in one year with that

the following year. This method avoids errors due to difference in the size of the trees, but it has the disadvantage of being based on the judgment of the observer, and not on actual weights. This latter method was adopted in the case of one series of observations on trees at Harpenden, and the former in the case of the other series on trees at Ridgmont.

Whichever method of observation was adopted the results were treated as follows; two selected trees were numbered 1 or 2, according to which of them bore the heavier crop in consecutive seasons; then, comparing the results in two consecutive seasons, if the order of fruiting had been the same (consecutive fruiting) the difference between the numbers given to the trees would be 0, if the order had been reversed (alternate fruiting) the difference would be 1; whereas if neither consecutive nor alternate fruiting prevailed, and the results were dependent on chance or on external conditions, the differences would, on the average, be 0.5. An average difference, for instance, of 0.75 would be halfway between 1 and 0.5, indicating that the results were dependent on the alternating tendency to the extent of 50 per cent., and on chance fruiting to the extent of 50 per cent. Some of the results obtained by this method are given in Table I.

TABLE I.

Place	Varieties	Dates	Instances	Fruiting indicated		
				Consecutive	Alternate	Chance
Harpenden	Several	1899-1903	332	0	44	56
Ridgmont	Bramley	1904-1913	1 050	12	0	88
"	Cox	1898-1909	840	16	0	84
"	Potts	1897-1904	1 266	5	0	95
"	Stirling	1897-1913	366	0	6	94
"	117 varieties	1906-1913	1 207	15	0	85

There can be no doubt but that the results at Harpenden and Ridgmont are very different, but the Harpenden results must be discounted to a certain extent as the number of instances available is smaller.

In Table II the yields from the Stirling Castle, Bramley and the Vay plantation are given, the numbers giving the relative magnitude of crops compared, in the case of Stirling Castle, with the crop in 1900 as 100, and, in the other cases, with that of 1911 as 100.

A plus or minus sign has been placed after the values showing whether they are above or below the means of the preceding and succeeding seasons, to the extent to which these signs alternate, though not without some regularities, is very remarkable. In the case of Cox and Potts no such alternations were recognisable. The chief factor affecting the alternation bearing in early flowering varieties is the incidence of spring frosts.

TABLE II.

	Stirling	Bramley	Varieties
1897	3	—	—
1898	30	—	—
1899	6 —	—	—
1900	100 +	—	—
1901	47 —	—	—
1902	144 +	—	—
1903	0 —	—	—
1904	148 +	35	0
1905	0 —	6 —	0 —
1906	144 +	7 +	12 —
1907	38 —	20 +	20 —
1908	95 +	7 —	15 —
1909	171 +	103 +	34 —
1910	264 +	9 —	13 —
1911	78 —	100 +	100 —
1912	47 —	0 —	10 —
1913	207 +	103 +	114 +
1914	0 —	0 —	0 —
1915	549 +	159 +	114 +

The results argue against any tendency in the individual trees towards alternate fruiting, as, if any such innate tendency existed, it would not be exhibited by different individuals in the same year: therefore in a plantation consisting of many individuals, even of the same variety, an average uniformity of production would result.

1292 - Sources of Supply of Hazel-nuts. — *Bulletin of the Imperial Institute*, Vol. XIV No. 2, pp. 261-267. London, April-June 1916.

The various kinds of hazel-nuts are the produce of species of *Corylus* a genus of shrubs or small trees native to the temperate parts of Europe, Asia and North America. The different kinds of nuts are distinguished by trade names according to their country of origin. A considerable quantity of hazel-nuts is produced in the United Kingdom, and supplementing the supply there is a large annual import derived chiefly from Spain, Italy and Asiatic Turkey. Hazel-nuts are not at present grown on a commercial scale in any of the British colonies. It is probable that hazel growing would succeed in parts of the Union of South Africa, British East Africa, Australia and Cyprus.

United Kingdom. — The hazel-nuts produced in this country are de

ved from cultivated forms of *Corylus Avellana*, or hybrids between that species and *C. maxima*. They are grown chiefly in Kent. Generally speaking, varieties in which the leafy cups are shorter than the nuts are termed cob-nuts, whilst those with cups as long as or longer than, the nuts are termed filberts. The varieties most commonly met with among the cob nuts are Kentish Cob or Lambert Filbert, Merveille de Bollwyller, Pearson's prolific and Berger; among the filberts, Red, White, Cosford, Frizzled. A yield of 100 tons of nuts has been frequently obtained from a plantation of 100 acres in Kent, whilst as high a yield as 2 ½ tons per acre was recorded for some localities in 1904. The value of hazel-nuts depends largely upon the size of the almond crops, for which they are used as a cheap substitute. The usual wholesale price is about 5d. per lb., but during the season 1915-1916 the prices ruled very high.

Spain. — In Spain the hazel-nut succeeds everywhere, but it is chiefly grown in the Catalan Provinces of Gerona and Tarragona. The nut bushes are usually grown in fields or gardens inter-cropped with other products. In Gerona the principal nut-growing area is the Selva, in the district of Santa Coloma de Farnés, whilst in Tarragona the crop is produced in the neighbourhood of the capital and at Tortosa and Montblanch. The fertile and moist soil of this area and the facilities for exporting these nuts have made nutgrowing a flourishing industry. The hazel-nuts imported into the United Kingdom from Spain are known on the market as Spanish and Barcelona nuts; the former are shipped from Gijón, a port in the Bay of Biscay, and the latter from Tarragona, a Mediterranean port. The Spanish nuts are grown in the Provinces of Galicia and Asturias, and are considered to be the produce of cultivated forms of *C. maxima*. The varieties chiefly grown are known locally as Mallorquina or Negreta de la Selva, a large nut with a hard reddish shell completely filled by the kernel, and Asturiana, which is a medium-sized or small nut produced in bunches of three or four.

The so-called Barcelona nuts, which are grown in Tarragona, are derived from *C. maxima* var. *barcelonensis*. The average yield is said to be about 55 lbs. of nuts per bush. As seen in commerce the nuts usually have a dark shell, which is due to their being kiln-dried in order to improve their keeping qualities. They are shipped from Tarragona in bags containing about 128 pounds each.

Of recent years there has been a demand for shelled nuts, which are shipped in bags weighing about 220 lbs. each. About half the entire crop as been exported in this condition, the principal importing countries being Germany, the United States, and the United Kingdom. The total annual crop of hazel-nuts produced in Spain is valued at over half a million sterling, whilst the quantity exported is valued at about £ 400 000.

Italy. — Large quantities of hazel-nuts are produced in South Italy, particularly in the province of Avellino. A considerable part of the crop is annually exported from Naples, chiefly to the United States, Germany, Holland, Austria-Ungary, France and the United Kingdom (arranged in order of importance). In 1909, 6 037 tons were exported from Naples and

in 1913 3777 tons. Of recent years Sicilian cob-nuts have attracted attention on the English market. These nuts are grown in woods at an elevation of more than 1200 feet above sea level. The highest yield recorded in Sicily was in the year 1913, when the crop amounted to 13 000 tons. These nuts have been sent chiefly to Central Europe from the ports of Palermo and Messina in bags of 50 kilos. (110 lbs.) each. In 1913 1 068 metric tons of hazel-nuts were exported from Palermo and 945 British tons from Messina.

Cyprus. — In Cyprus the hazel-nut grows luxuriantly in the hill villages, and the nuts produced are of good size and fine appearance. They are gathered before they attain full maturity so that they soon become rancid. The exports are at present small, and the extension of the cultivation of this crop in Cyprus is urged.

Asia Minor. — The hazel-nuts obtained from Asia Minor are known as Turkish or Trebizond nuts, and in former times they were spoken of as Pontic hazels. They are the produce of *Corylus Colurna* a tree of moderate size, attaining a height of 60 to 80 ft. if allowed to develop fully. This species, or one or other of its geographical forms is distributed from South-east Europe through Asia Minor and the Caucasus to the Himalayas and Western China. The cultivation of hazel-nuts for export is extensively carried on in the Black Sea coast region, from Khopa, on the Russian frontier, to Fatsa, which is just east of Unieh. Each tree produces annually from 16 to 24 lbs. of nuts, which are of three kinds: the round, the pointed, and the almond-shaped. The pointed are usually 10 per cent and the almond shaped 30 per cent dearer than the round nuts, which form about 70 per cent of the whole crop. The bulk of the round nuts are shelled before being shipped. The nuts are first sorted by revolving screens, then cracked by means of stone-mills, after which the kernels are dried in the sun and then packed in sacks for export. The shelling reduces the weight to half so that the freight charge is reduced by 50 per cent. 667 045 cwt. of hazel nuts were produced in the Trebizond Vilayet in 1913. The Ke-rassond is the chief district of production, its crop usually averaging from three-eighths to nearly five-eighths of the whole. The combined crops of Trebizond, Yomura, Off, Surmeneh, and Tazestan furnish between them from about one-quarter to three-eighths, whilst the remainder comes from the Tripoli Eleon, Ordu, and Sharli Fol districts in unequal proportions. Of the exports, about 48 per cent. have usually gone to Germany, 22 per cent. to Austria-Hungary, and about 14 per cent. to France and the United Kingdom. Exports to Russia have practically ceased, as nuts are successfully grown within Russian territory from Batum to Soukhoun Kaleb.

Hazel nuts are used as dessert-nuts, and also in the preparation of various nut foods and nut chocolate. They yield a bland golden-yellow oil which resembles almond oil, but has a lower iodine value.

The composition of fresh kernels of hazel (filbert) nuts is shown in the following table:

	Hazel-nut kernels Per cent
Water	48.0
Crude proteins	8.4
Fat	28.5
Starch, etc. (by difference).	11.1
Fibre	2.5
Ash	1.5
Nutrient ratio	1 : 9.12
Foods units	103.4

1293 - **Vine Growing at Benghazi, Tripoli.** — ZANON V., in *Giornale di Agricoltura della Domenica*, Year XXVI, No. 43, p. 347. Piacenza, October 22, 1916.

VINE GROWING

The region of Benghazi is very suitable in climate and soil for vine growing. The mean annual temperature does not exceed 68.7°F; the range of temperature is the best for obtaining an early harvest (the ordinary grape ripens there at the end of June or the beginning of July), while the sharp changes of temperature in the spring do not interfere with the ripening of the fruit; the annual rainfall is 18 inches. This precipitation is not sufficient to give a good harvest after a few years growth unless other water can be utilised, consequently the vineyards are only established in the neighbourhood of the ouadāi, the torrent which collects the rainfall from the mountain zone, and they are so placed that the water may be rapidly distributed. Under the local system of cultivation the shoots of the vines are wisely left to spread freely over the earth so that the gales do no damage. With the exception of a narrow sandy area which borders the district the soil is a red ferruginous calcareous clay, the best that exists in Libya. As a rule the red soils of Benghazi are very rich in potash and phosphorus, they contain varying proportions of chalk in different localities and are always deficient in humus.

The vines are always kept low, and in gardens in inhabited areas they are even cradled in the ground. Two ditches, 30-36 inches deep and 20 inches wide are dug when planting and the earth is thrown up in the direction of the wind so as to form a shelter for the young plant which is thus well protected. Later on the earth is gradually levelled for greater convenience at the time of annual cultivation. Cuttings are always planted and 3-year old vines have shoots from 23 to 30 feet long.

Nearly all the varieties of vines grown in Benghazi and its environs are of Greek origin, chiefly from Candia. Six of them are thus described:

- 1) *White grape*: the earliest variety.
- 2) *White grape of Constantinople*, called Karidata by the Greeks: an excellent table grape.
- 3) *Black grape of Candia*: this is the most commonly grown vine in Benghazi and its environs; very hardy, growth luxuriant, bunch winged, sometimes very large (up to 4 ½ to 6 ½ lbs.), with large berries (reaching 1 ¼ inch in diameter).
- 4) *Black grape*: much less luxuriant and productive than the preceding; bunch elongated, usually simple.

5) *Black grape of Canea*, called *Stafili Romeika* by the Greeks: used for wine making.

6) *Red grape*: strong growing plant; bunch very large, winged, compact, but difficult to transport because of the watery pulp of the berries and the thinness of the skins.

It is probable that the method of cultivation could be improved by

- 1) spacing the rows at least 6 $\frac{1}{2}$ feet apart.
- 2) deep working of the soil.
- 3) use of chemical manures.

It is useless to attempt to establish vineyards where the *ouadai* does not come, or to grow the plants on the system of training them above the level of the soil.

In addition to table grapes the colony produces sufficient wine for its own consumption.

LIVE STOCK AND BREEDING.

HYGIENE
OF LIVE STOCK

1294 - **The Immunisation of Cattle against Tuberculosis; Results of 10 Years' Trials Carried out at the Leipzig Veterinary Institute.** — EDER A., in *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, Vol. 78, No. 5, pp. 331-364. Jena, October 12, 1916.

In the spring of 1904 some large herds of cattle were vaccinated as a preventive measure against tuberculosis. The experiments were undertaken largely as a result of work done at the Veterinary Institute of Leipzig between 1902 and 1904 when, at the instigation of VON BEHRING, two animals were given a course of hypodermic and intravenous injections of vaccine and then tested for resistance to virus from an infected subject. They proved more resistant than untreated animals, so it was decided to extend the trials on a large scale using von Behring's «Bovovaccin» for the purpose. The following year another vaccine, «Tauruman», was tested, and in 1908 Klimmer's «Antiphymatol» was also used according to the methods of HEYMANS of Ghent.

Altogether 797 head of cattle were immunised during the 10 years' trials, while 169 animals were used as controls, and the experiments were distributed over 12 estates which represented different types of stock management in the Kingdom of Saxony, in Prussia and in the Duchy of Saxe-Altenberg. No fees of any kind were charged for vaccination but the owners of the herds were expected to give immediate notice of the death or slaughter of a treated subject, so that a careful post-mortem examination could be made. The total number of deaths and slaughterings notified amounted to 258 of which 39 were control animals. Whenever possible the post-mortem was carried out by the writer himself, failing which it was entrusted to a local veterinary surgeon who was given a special form on which to record his results.

Periodic tuberculin tests were also made both before and after vacci-

nation and throughout the experiment stress was laid less on the number of cases dealt with than on a careful study of the subjects actually treated.

It is pointed out that as in all other trials bearing on the propagation of tuberculosis, vaccination must be accompanied by prophylactic measures and must be carried out under strictly hygienic conditions. Consequently it is extremely difficult to distinguish between the effects of the vaccine and those due to the improved conditions of life. The experiments did not indicate that better results were obtained where vaccination was practised than when the treatment was confined to prophylactic measures alone. A special study was made of the efficiency of the Heymans vaccine. Though it cannot be denied that vaccines containing tubercle bacilli, such as "Heymans' capsules", have shown a certain curative effect on tuberculous subjects when used year after year, and have therefore tended to check the spread of the disease in a herd, their action is quite uncertain and frequently fails without any apparent reason. Except in very occasional cases, no permanent cure has been obtained, symptoms of the disease reappearing even in spite of repeated vaccinations. Further, in four herds which were only slightly infected, three of which were being treated with Heymans' vaccine and the other Antiphymatol, the result of vaccination was to make latent form of tuberculosis of the udder suddenly active. On the whole it may be said that the curative effects of vaccination are not of an order to make it a reliable means of checking tuberculosis in cattle.

The trials were interrupted at the outbreak of the War.

295 - A New Parasite on Sheep Maggot Flies (1). - PROGGATT W. W., in *Queensland Agricultural Journal*, Vol. VI, No. 3, pp. 177-179. Brisbane, September 1916.

At the Government Sheep-fly Experiment Station, Woolloomooloo, (near Hay), a new chalcid parasite (*Chalcis calliphorae*) has been discovered by T. McCARTHY on blowfly maggots (*Calliphora oecariae*). It consists of a small black wasp, about the size of the common house fly and it lays a single egg in each maggot before the latter seeks cover to pupate. The new parasite is hardy, easy to breed and will stand a long journey by post in a packet.

Nasonia brevicornis, which is already known as a parasite of the blowfly maggot, is more prolific than *Chalcis calliphorae* and equally hardy, but it does not attack the maggots till after they have pupated.

296 - A New Unit for the Estimation of Food Values. - SUCHTING H., in *Journal für Landwirtschaft*, Vol. 64, No. 3, pp. 165-170. Berlin, October 19, 1916.

Kellner's "starch value" is a unit adopted for estimating and comparing the value of different foods and is estimated by converting all other substances in foods into terms of starch. This unit has been preferred to the "calorie" or energy unit for the practical reason that it is much larger and therefore simplifies calculations. The writer challenges the impracticability of the calorie and shows how it may be modified for use. Kellner always stated his starch values to a tenth of a kg. and with such a degree

FEEDS
AND FEEDING

(1 See also B. 1914, No. 1017; K. 1915, Nos. 401 and 1051.

of accuracy the equivalent calorie value certainly runs into large and unwieldy numbers; but as the starch value of any one food is by no means constant and fluctuates to the extent of anything between 10 and 100 per cent according to the nature of the food, it would seem quite unnecessary to go into decimals of starch values. The writer proposes that a unit of 1 000 calories be adopted in the place of starch values (and decimals of starch value) and points out that even this unit is too small as 1 000 calories are equivalent to 0.25 kg. of starch. He considers this new unit to be more practical, simpler and more exact than starch values. From the physiological point of view too, it is more satisfactory to compare the animal body to an engine supplied with fuel and to obtain the food value in terms of the fuel, which can then be easily be converted into force, than to obtain the food value in terms of one of the substances in the food.

The value of digestible food substances would thus be expressed in heat units or large calories for which the name of "Kellner values" is proposed, and 1 kg. of starch, protein and fat would be equivalent to 4.4 and 9 Kellner values respectively. For example the Kellner value of 100 kgs. of wheat (95 per cent digestible) containing 9 per cent of protein, 1 per cent of fat and 64 per cent of nitrogen free extract would be:

$$\begin{array}{rcl}
 9 \text{ kgs. protein} & & = 9 \times 4 = 36 \\
 1 \text{ " fat} & & = 1 \times 9 = 9 \\
 64 \text{ " N-free extract} & . . & = 64 \times 4 = 256 \\
 \text{Total} & & = 301 \\
 \text{or } \frac{300 \times 95}{100} & = & 285 \text{ Kellner values.}
 \end{array}$$

HORSES

1297 - **The Horse-Breeding Industry in Saskatchewan.** — *The Agricultural Gazette of Canada*. Vol. 3, No. 8, pp. 705. Ottawa, August 1916.

The development of the horse breeding industry in Saskatchewan in the last 15 years, has been a considerable one, as indicated by the following figures, in which those for 1881 and 1891 are for Alberta and Saskatchewan combined:

Year	Numbers of horses
1881	10 870
1891	60 976
1901	83 801
1911	507 468
1915	667 443

At an early date some of the horse ranches began the use of draft stallions for breeding purposes, although most of them used thorough bred sires and raised a lighter type of animal. At present the use of sires of the draft breeds is the rule rather than the exception as the accompanying enrolment figures for 1916 indicate:

Clydesdale	1868
Percheron	670
Shire	68
Standard Bred	189
Hackney	52
Throughbred	27
French Canadian	1
French Coach	3
German Coach	7
Suffolk	36
Belgian Draft	126
Saddle Horse	6
Shetland Pony	1
Morgan	1
Jack	1
<hr/>	
Total pure breeds	3 056
Grades	606
Crossbreds	2
Scrubs	584
<hr/>	
Total	4 248

Advanced legislation with respect to horse breeding provides for the annual enrolment of all stallions used for breeding purposes and the examination and licensing of all stallions used for service in municipalities included in the Licensed stallion District.

Saskatchewan Clydesdale are famous throughout Canada as representative of the best development, of this famous breed and show ring champions both male and female are owned by Saskatchewan breeders.

68 - **Gestation and Sterility in Cows.** — STALFORS H., in *Monatshefte für praktische Tierheilkunde*, Vol. 27, No. 7-8, pp. 338-358. Stuttgart, May 27, 1916.

CATTLE

I. *Studies on gestation.* — During the years 1907 to 1915 a large number of in-calf cows were examined for the purpose of determining in which part of the uterus the foetus was carried. The examinations were made at some time between the sixth and fifteenth week of gestation, that period being the most favourable for the operation; fluctuation, asymmetry and an increase in size of the uterus were taken as symptoms of pregnancy. In at least half the animals under experiment the ovaries were also examined for corpora lutea though no records were kept of the observations.

Out of a total of 923 cows examined, 577 cows or 62.5 per cent of the cows carried the foetus in the right horn of the womb, and 346 in the left horn, proportions which are approximately those found by other workers. In 105 of the cows, the animals were kept under observation for two successive periods of gestation and in 62 of the cases the foetus was twice tried in the same horn, indicating that the one ovary was rather more productive than the other. The greater productivity of the right ovary with respect to the left is attributed to the pressure exerted by the paunch on the nerves and blood vessels of the left side as well as on the left ovary itself.

It was observed that the fertilised ovum frequently began its development in the body of the uterus rather than in the horn and only passed definitely into the horn at a later stage. This fact has been denied by many investigators, but in the present experiments considerable development and fluctuation was noted in the body of the uterus between the fourth and sixth weeks of gestation, whilst the horns remained about the same size.

II. *Influence of handling on the productiveness of ovaries.* — From 1910 to 1915 six herds containing from 12 to 100 cows each were kept under special observation being visited every 4 to 8 weeks and any barren animals were subjected to an operation on the ovaries. This consisted in an exploration per rectum and of a squeezing or crushing of corpora lutea or cysts which might have persisted in the ovaries. The uterine catarrh resulting from the operation was treated at the same time by vaginal injections. Out of 264 cows so treated more than half became normally productive again.

It is quite evident from the results of the experiments that the function of the ovaries was not interfered with by the handling, on the contrary it appeared to make them more productive. In 146 out of 211 cases of pregnancy after treatment (59.2 per cent) it was possible to trace the fertilised ovum to the ovary which had been treated. A number of these pregnant cows were maintained under observation and out of a total of 133, 81, 60.9 per cent proved to have become absolutely normal again including a case of uterine catarrh independent of the ovaries. And of these normal pregnant cows, in 63 out of 77 cases (81.8 per cent) the fertilised ovum was traced to the treated ovary.

Conclusions. — In the cow the foetus is borne in the right horn the uterus more frequently than in the left, the frequencies being as 64 to 3.

The treatment of the ovaries by handling, if not carried out too violently, exerts no depressing, debilitating or deleterious action on the sex functions or on the productivity of the ovaries. It may on the contrary reestablish and increase the functions of the ovary when the latter has been interfered with by such things as the persistence of corpora lutea or cysts in the ovary.

1299 — **The Advantages of Winter Calving.** — GOUIN A., in *Comptes Rendus de l'Académie d'Agriculture de France*, Vol. II, No. 33, pp. 972-973. Paris, October 25, 1916.

Winter calves are often considered unsatisfactory, being looked upon as delicate and unsuitable for breeding stock. The writer brings forward his own experience which is in contradiction to these views. Between 189 and 1913 he bred and raised 127 yearlings, chiefly heifers, of which 39 were born during the months of October to January and 88 from February to September. At twelve months the average weight of the winter calves was 561 lbs. and that of the spring and summer calves 600 lbs. Of the 127 yearlings, 60 were eventually brought into the milking herd and the weights three months before calving were 113 lbs. for the 20 born in winter while the other 40 only averaged 2 lbs. more.

The season of birth would therefore seem to have no influence on the

climate development of the animals, and where artificial rearing is practised winter calving is certainly more economical, for by feeding skim milk and a fat substitute the calves got on very well till the spring when they were old enough to take full advantage of the grass; and when they were brought in the following winter, the winter calves had a big start over the summer ones and were able to be put at once on to a more economical ration.

1. — **Capra prisca an Unknown and Extinct Race of the European Domesticated Goat.** — ADAMETZ, in *Mitteilungen der landw. Lehrkanzeln der K. K. Hochschule für Bodenkultur in Wien*, Vol. 3, No. 1, pp. 1-21. Vienna, 1915.

GOATS

In 1913, a portion of fairly well preserved skull belonging to a fossil goat was received for examination from Prof. ED. VON LUBICZ VIERZATINSKI. It had been found together with two other similar skulls and the remains of a horse's skull when laying a water main at Ilcozow in Eastern Galicia, at a depth of 15 ft. from the surface. A careful study of the skull showed that it belonged to a well defined extinct species of wild goat which was given the name of *Capri prisca* n. sp.

Up to the present it has been considered that the different varieties of the European domesticated goat are all descended from a common ancestor which is still represented by the Bezoar wild goat (*C. aegagrus*); and the fact that the position and conformation of the horns and rudimentary horns in the domesticated goats differ markedly from those of the wild goat has been attributed to somatic variation or mutation. When the skulls of *C. aegagrus* and of its sub-species the Cretan goat (*C. aegagrus cretensis*) and the wild goat of the Island of Erimomilos (*C. aegagrus pictus*) were compared with the skull of *C. prisca* the conformation of the chief bones was found to be different. But on the other hand the conformation of the skull of *C. prisca* was absolutely identical with that of the so-called wild goat (*C. dorcas* Reichw. or *C. hircus dorcas* according to DE RENZ-LEBURNAU) who proved it to be merely a goat reverted to the wild type, and very similar to that of the majority of the European domesticated breeds, in particular the goats of Bosnia-Herzegovina, of Serbia and Albania.

It would therefore seem that the hypothesis of the Bezoar goat as the ancestor of the European domesticated breeds is untenable, as most of the latter are more probably derived from *C. prisca*. Some breeds however, such as for instance the old Alpine breed of Salzburg, are just as clearly related to *C. aegagrus*.

The writer is proceeding with a thorough examination of all available prehistoric material in the light of this latest discovery.

— **Fish Meal as Food for Pigs.** — CROWTHER C., in *The Journal of the Board of Agriculture*, Vol. XXIII, No. 1, pp. 27-33. London, April 1916.

PIGS

At the Experimental Farm of the University of Leeds (Garforth) feeding trials were carried out to test the value of fish meal as food for pigs. The large white pigs ranging in age from 13 to 21 weeks were divided into two lots as evenly as possible, each lot consisting of 3 castrated hogs

TABLE I. — *Plan of experiment.*

Period	General character of feeding	Average daily ration per lot of	
		Lot A	Lot B
Preliminary control 4 weeks June 15 to July 13	Identical for both lots. No fish meal.	Bran 2.4 Sharps. 12.0 Water. 72	
First transitional 1 week July 14 to 20	Fish meal gradually introduced into ration of lot A in place of equal weight of sharps.	Bran 3.0 Sharps. 13.5 Fish meal 1.5 Water. 90	
First experimental 6 weeks July 21 to August 31	Lot A: bran, sharps, fish meal. Lot B: bran, sharps.	Bran 4.1 Sharps. 18.1 Fish meal 2.7 Water. 107	
Second transitional 1 week September 1 to 7	Rations gradually transposed.	Bran 5.8 Sharps. 27.5 Fish meal 1.4 Water. 139	
Second experimental 6 weeks Sept. 8 to October 19	Lot A: bran, sharps. Lot B: bran, sharps, fish meal.	Bran 6.5 Sharps. 32.5 Fish meal — Water. 146	
Third transitional 1 week October 20 to 26	Fish meal gradually introduced into ration of lot A. Ration of lot B unchanged.	Bran 8 Sharps. 36 Fish meal 4 Water. 160	
Final control 3 weeks Oct. 27 to Nov. 17	Identical for both lots. Fish meal included in ration.	Bran 9.8 Sharps. 42.2 Fish meal 7.0 Water. 182	

and 3 gilts. The experiment began on June 15, 1915 and lasted 22 w. For the first 4 weeks each lot was given the same ration of bran and sh. Fish meal was then gradually introduced into the ration of lot A in place of an equal weight of sharps. Seven weeks later the rations gradually transposed, the fish meal being gradually replaced by sharps the ration of Lot A and introduced in the place of sharps in the ratio

TABLE II. — *Composition of fish meal*

	Meal used in experiment	Average of 7 samples
	per cent	per cent
Moisture	4.6	12.9
Protein	52.7	55.8
Oil	6.7	3.8
Fish, including	25.3	25.3
Phosphoric acid	9.5	8.6
Chorides expressed as NaCl	2.6	2.2

TABLE III. — *Average weekly gain in live weight per pig.*

Period	Lot A			Lot B		
	Hogs	Gilts	Average	Hogs	Gilts	Average
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
preliminary control	5.3	5.5	5.4	4.8	5.2	5.0
first experimental	11.0	10.6	10.8	8.3	10.8	9.5
second "	10.3	9.0	9.7	11.5	10.6	11.1
final control	15.4	12.0	13.7	12.5	11.1	11.8 (1)

(1) This average is depressed by the abnormally low gain recorded in the last week when 2 gilts, being in oestro, not only failed to gain in weight, but caused general disturbance of the whole lot. The average for the preceding 2 weeks were: Lot A, 14.4 lbs.; Lot B, 14.7 lbs.

of B. Seven weeks later again fish meal was once more substituted for an equal weight of sharps in the ration of Lot A, but was not removed from the ration of Lot B, so that for the last 4 weeks each lot received fish meal along with the bran and sharps and for the last 3 weeks the rations were identical in every respect. The general plan of the experiment is summarised in Table I.

The composition of the fish meal used is given in Table II, average gains in live weight are summarised in Table III, and in Table IV are set out the quantity of foodstuffs consumed and the average cost of the rations used on the following prices per ton:

	£	s	d
Bran	6	16	4
Sharps	9	12	6
Fish meal	10	10	0

Fish meal as compared with sharps effected an extra gain in live weight of 1.3 lb. per pig per week on the average of the first experimental

TABLE IV. — *Average amount and cost of weekly ration per pig.*

	Lot A		Lot B	
	Weight	Cost	Weight	Cost
	lbs.	d	lbs.	d
<i>First experimental period.</i>				
Bran	4.8	3.50	4.8	3.50
Sharps	21.1	21.73	24.2	24.92
Fish meal	3.1	3.49	—	—
Total . . .	29.0	28.72	29.0	28.43
<i>Second experimental period.</i>				
Bran	7.6	5.55	7.6	5.55
Sharps	37.9	39.04	31.6	32.55
Fish meal	—	—	6.3	7.09
Total . . .	45.5	44.59	45.5	45.19
	With fish meal		Without fish meal	
	Weight	Cost	Weight	Cost
	lbs.	d	lbs.	d
<i>The two periods combined.</i>				
Bran	6.2	4.53	6.2	4.53
Sharps	26.35	27.14	31.05	31.98
Fish meal	4.7	5.29	—	—
Total . . .	37.25	36.96	37.25	36.51

period and of 1.4 lb. per pig per week on the average of the second experimental period or an average gain for the whole period of 1.35 lb. weekly. On the other hand the use of fish meal to the extent of one eighth of the total ration as a substitute for an equal weight of sharps increased the cost of feeding by barely $\frac{1}{2}$ d per pig per week. If, further, the residual manurial values be allowed on the scale suggested by Hall and Voelcker the fish meal becomes actually cheaper since the manurial value of the fish meal is £ 4 8s per ton, whilst that of the sharps is but £ 1 9s per ton. But even leaving out of account the manurial value and considering only the live weight gains, there can be no doubt as to the decided benefit of partially replacing sharps by fish meal.

No objectional taint was imparted to the carcass of the animal by the use of fish meal.

1302 - **Poultry Breeding in Tunis; Imported and Native Breeds.** — CHENEVARD W., in *Bulletin de la Société d'Horticulture de Tunisie*, Year 14, No. 99, pp. 157-160. Tunis, October 15, 1916.

POULT

"Kabyles" is the term commonly used for all native poultry in Tunis, but for practical purposes the three following classes may be distinguished:

1) The true Kabyle, generally partridge colour with a long body, yellow legs and a weight which rarely goes above 2 lbs.

2) The Arab type which is rather a better kind of bird, more compact in form, with yellow or green legs and various colourings of plumage, generally tending towards a yellow brown; its average weight is 2.2 to 2.6 lbs.

3) All other birds.

Good results have been obtained with the Arab by selection and by crossing with imported varieties, birds weighing up to 3 to 4.5 lbs. being obtained, but the quality of the flesh is very poor. Kabyles are too small ever to prove of economic importance.

An experiment was carried out in which the weights of birds of the Arab type were compared with those of a Malines cross known as the Tunisian Cuckoo throughout the period of their growth. The mean figures are given below.

	Weight of egg or chick	
	Tunisian Cuckoo oz.	Arab oz.
Egg before incubation	—	—
" after 5 days incubation	2.07	1.75
" " 10 " "	1.96	1.65
" " 15 " "	1.86	1.58
" " 21-22 " "	1.75	1.47
chick 1.40	1.26	1.40
shell 0.25		
Loss of weight during incubation	0.42	0.35
Chick 3 days old	1.30	1.12
" 5 " "	1.30	1.26
" 10 " "	1.75	1.30
" 15 " "	2.07	1.43
" 20 " "	2.63	1.68
" 25 " "	3.53	2.07
" 30 " "	5.53	2.98
" 45 " "	12.60	5.75
" 60 " "	21.70	9.59
" 75 " "	30.40	13.13
" 90 " "	44.10	18.38
" 105 " "	59.50 or $3\frac{3}{4}$ lbs.	24.68 or $1\frac{1}{4}$ lb.

The feeding consisted of hard egg and bread sop to start with, followed by barley mash, cooked rice and sour milk together with millet and oil corn, the consumption per head up to 105 days old and per lb. of live weight being as follows:

	Tunisian Cuckoo		Arab	
	Per head lbs.	Per lb. live weight lbs.	Per head lbs.	Per lb. live weight lbs.
Dry matter	21.6	5.8	9.16	5.9
Digestible protein	2.9	0.8	1.3	0.9
" fat	1.5	0.4	0.7	0.5
" carbohydrates	12.7	3.4	5.8	3.7
Cellulose	0.5	0.1	2.0	0.1
Starch value	16.1	4.3	7.4	1.8

The Arab birds required about 10 per cent more food than the Tunisian Cuckoo.

1303 - **Fecundity in Relation to Stamina.** — DUNNIGLIFF (Jun.) A. A., in *The Agriculture Gazette of New South Wales*, Vol. XXVII, No. 7, pp. 507-510, Sydney, July 1916.

The danger signal has been raised by more or less authoritative critics in various parts of the world that striving for higher and higher egg production, and the breeding from hens of great fecundity, can only result in degeneration of the constitution of the stock and consequent disaster to the breeder. Egg laying competitions have been pointed out as exercising a dangerous influence in this direction. In New South Wales however where these competitions have been in progress longer than in any other part of the world there is no evidence of loss of stamina in very prolific birds. The attainments of high records in this country has never been subordinated to practical and utilitarian considerations, restrictions having always existed with regard to quality, size of eggs, and weight of pullets.

It is instructive to trace the results of breeding from hens that have put up high records in competitions. For instance, the pen of White Leghorns which won the second two-years' test with 1474 and 1150 eggs in the first and second years respectively and the pen which won the fourth two-years' test with 1324 and 1045 eggs both belonged to the same owner and proved entirely satisfactory as breeders both as regards fertility and constitutional vigour of the progeny. Another example is the White Leghorn hens which won the 1912-1913 competition with 1461 eggs and which were used later with other birds of the same stock in the single pen test of 1914-1915 when they achieved a world's record. The four best hens in that group had individual records of 267, 270, 270, 288 eggs, yet when used afterwards for breeding, they gave no evidence of having suffered constitutionally from the strain of the great production.

The available evidence warrants the conclusion that a hen is not to be regarded as a doubtful transmitter of stamina to her progeny because she is the possessor of the faculty of fecundity in a high degree. The 200 egg hen has now become a commonplace in Australia and there seems no reason why it should not be eventually replaced by strains producing 250 eggs or even more.

1304 - **The Distribution of Fish and Fish Eggs during the Fiscal Year Ending 1915.** — JOHNSON R. S., *Department of Commerce, Bureau of Fisheries, Document No. 828*, pp. 1-131, Washington, D. C., 1916.

During the fiscal year 1914-1915 the breeding establishment of the U.S. Bureau of Fisheries bred and distributed about fifty species of fresh

Number of eggs, small fry and small fish distributed
by the U. S. Bureau of Fisheries during the fiscal year 1914-1915.

	Eggs	Small fry	Small fish, one year old fish, full grown fish	Total
<i>salmo</i> spp.	—	—	1 665 793	1 665 793
<i>prinus carpio</i>	—	—	644 411	644 411
<i>lestomus commersoni</i>	—	—	200	200
<i>salmo</i> spp.	—	—	114 849	114 849
<i>salmo</i> spp.	—	—	65	65
<i>salmo</i> spp.	—	46 009 595	—	46 009 595
<i>regulus albus</i> and <i>C. clupeaformis</i>	98 900 000	4 851 000	—	4 851 000
<i>acikthys arcti</i>	—	405 400 000	—	504 300 000
<i>chlorhynchus hisutich</i>	—	92 350 000	—	92 350 000
<i>chlorhynchus tschawyscha</i>	1 948 280	21 204 230	2 756 062	25 908 572
<i>chlorhynchus nerka</i>	34 466 723	44 554 892	16 741 450	95 763 065
<i>chlorhynchus gorbusha</i>	3 155 000	43 776 741	8 666 255	55 597 996
<i>chlorhynchus keta</i>	—	11 758 500	479 037	12 237 537
<i>mo gairdneri</i>	—	35 504 707	—	35 504 707
<i>mo irideus</i>	634 000	2 259 113	3 244 660	6 137 773
<i>mo salar</i>	2 022 990	568 930	2 144 875	4 736 795
<i>mo sebago</i>	—	1 804 313	—	1 804 313
<i>mo trutta</i>	291 000	310 042	140 015	741 057
<i>mo henshawi</i>	—	58 430	—	58 430
<i>mo trutta leuiscus</i>	3 435 000	1 939 250	4 784 067	10 158 317
<i>stomox namaycush</i>	12 850 000	35 294 000	48 000	48 000
<i>stomox fontinalis</i>	507 150	5 700 263	3 093 723	51 238 468
<i>urus mordax</i>	14 500 000	6 900 000	6 965 167	13 172 580
<i>malis montanus</i>	350 000	1 873 000	—	21 400 000
<i>urus annularis</i>	—	—	—	2 223 000
<i>urus sparoides</i>	—	—	1 800 430	1 800 430
<i>biophilus rupestris</i>	—	—	470	470
<i>ropterus dolomieu</i>	—	653 170	414 078	414 078
<i>ropterus salmoides</i>	—	758 300	81 177	734 347
<i>omis pallidus</i>	—	135 000	1 431 850	2 190 150
<i>salmo</i> and <i>E. reticulatus</i>	—	—	2 799 766	2 934 766
<i>ostion vitreum</i>	326 350 000	282 820 000	87 846	87 846
<i>sa flavescens</i>	19 000 000	195 267 000	383	609 170 383
<i>rus lineatus</i>	—	8 594 500	104 257	214 371 287
<i>rus americana</i>	17 850 000	161 980 000	—	8 544 500
<i>rus chrysops</i>	—	—	2 825	179 830 000
<i>rus interrupta</i>	—	—	420	2 825
<i>lus callarias</i>	—	260 133 000	—	420
<i>lactus virens</i>	—	500 730 000	—	260 133 000
<i>ster scombrus</i>	—	4 847 000	—	500 730 000
<i>anogrammus aeglefinus</i>	—	26 814 000	—	4 847 000
<i>adopleuronectes americanus</i>	—	1 294 156 000	—	26 814 000
<i>aga onitis</i>	—	606 000	—	1 294 156 000
<i>urus americanus</i>	—	194 670 000	3 779	606 000
Totals	536 260 143	3 694 281 699	58 215 962	4 288 757 804

water fish excluding the nacreous shell fish (*Lampsilis ventricosa*, *L. gamentia*, *L. luteola*, *L. recta*, *L. anodontoidea*, *Plagiola securis*, *Quadrup pustulosa*) and the American crayfish (*Homarus americanus*). Other species were captured during a flood in the basin of the Mississippi and replaced in their respective rivers after the flood had subsided.

The adjoining Table shows the amount of restocking actually accomplished. "Small fry" is used to designate newly born fish, and "smg fish" are those about the size of a finger.

VARIOUS

1305 - Feeding Experiments with Rabbits. — DAVIES C. J., in *The Journal of the Boy of Agriculture*, Vol. XXIII, No. 6, pp. 583-585, London, September 1916.

In order to obtain precise details of the relative merits of various concentrated foods, of the total amount of food consumed and of the cost of rearing, 8 rabbits of similar breed, belonging to two litters of about the same age, were experimentally fed for 6 weeks in the summer of 1916. The results of the experiments are given in Tables I and II.

TABLE I. — Daily ration of each pair of rabbits.

	Age of rabbits in weeks					
	1	2	3	4	5	6
	oz.	oz.	oz.	oz.	oz.	oz.
Concentrated food	1	1	1	1.5	2	2
Clover hay	1	1	1	1	1	1
Green stuff	10	14	16	16	16	16

TABLE II. — Cost of concentrated food and live weight increase.

Lot	Concentrated food	Content of:		Cost of food per lb. (1)	Total cost of concentrated food per head	Average liveweight increase per head
		Protein	Oil			
		Per cent	Per cent	d	d	lb. oz.
1	Bran	14	4	1	2	1 9
2	Oats	12	6	2	4	1 10
3	Bran, 2 parts					
	Oat meal, 1 part	18	6	1.5	3	1 10
	Dairy cake, 1 part					
4	Dairy cake	24	6	1.5	3	1 3

(1) Maximum prices for food bought locally in small quantities.

All rabbits received water to drink and a lump of rock salt to lick also a daily allowance of clover hay and freshly cut green stuff. The pair fed on dairy cake (Lot 4) gave poor results which were due partly to the

fact that one rabbit disliked it and seldom ate her share. At the end of the experiment Lot 3 carried the most flesh and the mixture they received was used successfully throughout the year, giving support to the view that a mixture of foods is better than single foods.

The experiments show that oats can be very well replaced by cheaper foods and that rabbits can be reared for the 6 weeks of their greatest growth in summer at a cost of $\frac{1}{2}d$ per week for concentrated food. Roughly speaking it was found that it took some 15 lbs. of food to produce 1 lb. increase live weight and this figure agrees very well with the observations made by the writer many years ago when it was estimated that each rabbit increased 1 lb. for every 12 lbs. of food consumed. During the 6 weeks experimental period each rabbit produced 9 to 10 lbs. of dry and liquid manure.

FARM ENGINEERING.

1306 - **New Dressing Machine for Spherical Grain.** — *Illustrierte landwirtschaftliche Zeitung*, 36th Year, No. 64, pp. 429-430. Berlin, August 9, 1916.

In plate dressing machines of the usual type, seeds which are not perfectly round or those having flat surfaces on them, either stay on the plate or move along very slowly and leave it reluctantly. This causes seeds of inferior quality to fall into the hopper.

On the other hand, in the new machine described here, (made by ERNST LÖSCHE at Koenigsberg, Prussia; German Patent No. 292 667), a step device causes the seeds to make a kind of jump which allows them to roll and to leave the plate at the proper moment. Again, the fact that the external ring of the plate is adjustable, allows the individual characteristics of each kind of seed to be provided for and gives most efficient separation. Another novelty consists in the adjustability of the carrier platforms situated in the annular discharge channels. In this way the classification of the different kinds of grain can be varied at will. Finally the rousing shaft fixed in the feed channel is a very useful improvement; it keeps the grain in constant motion and prevents the formation of heaps. The friction rid the grain of husks, stalks, etc., while sand and other impurities are led to a sieve at the bottom of the feed channel and thus do not reach the dressing plates. Fig. 1 shows a complete view of the machine; fig. 2 a horizontal section at *A B*; fig. 3 a portion of the annular channel with the carrier platform *p* controlled through the window *O*; and fig. 4. is a vertical section of a dressing plate and feed channel, showing also the under side of a dressing plate with adjusting wing-nuts *l*; the position of the rousing shaft *h* is indicated together with its driving-bevel *e*.

As shown in fig. 1, the three pillars *a* of the frame function also as discharge channels and are connected by the cross-piece *h*. The frame carries the cylindrical feed channel *c* which at its upper end has a driving-bevel *e*, running on a ball-bearing *d*. From this bevel the dressing plates *j* are suspended by stay-bolts. The shaft *h* forms the axis of the bevel *e*. It is

AGRICULTURAL
MACHINERY
AND
IMPLEMENTS

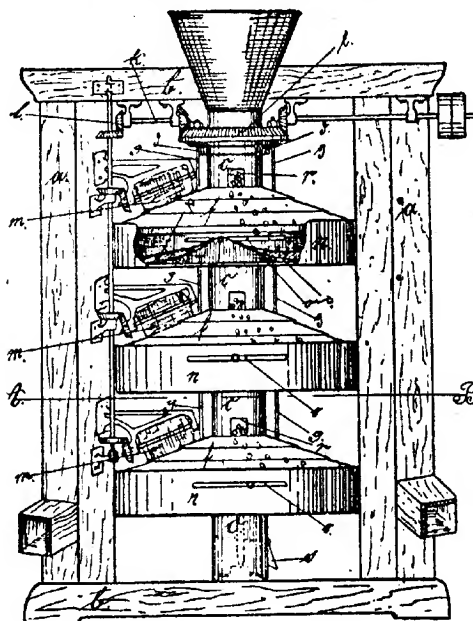
New dressing machine for spherical grain.

Fig. 1. Complete machine.

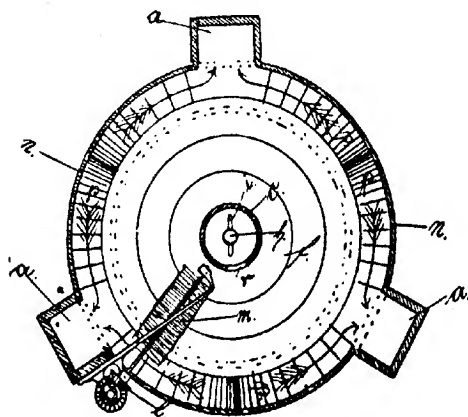


Fig. 2. Horizontal section at A B.

furnished with rousing fingers and the lower end runs on a step-bearing at the bottom of the feed-channel (as indicated in fig. 1). The bevel *e*, which is driven by any suitable power, drives a series of brushes *m* by means of the shaft *h* and the bevel-gears *l*. The pillars *a* are connected with the annular channels *n* in which the platforms *p* are situated. The latter are regulated through the slots *o* and carry the dressed grain in the pillars to the internal discharge channel.

New dressing machine for spherical grain.

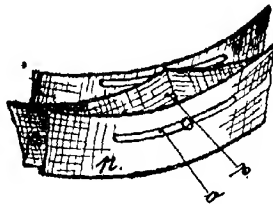


Fig. 3. — A portion of the annular channel with the carrier platform *p*. controlled through the window *o*.

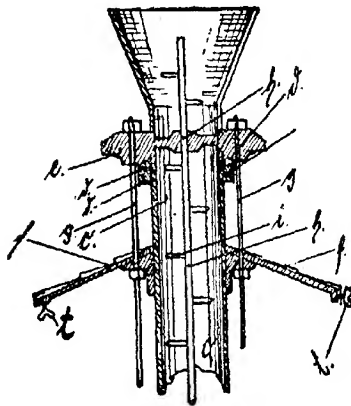


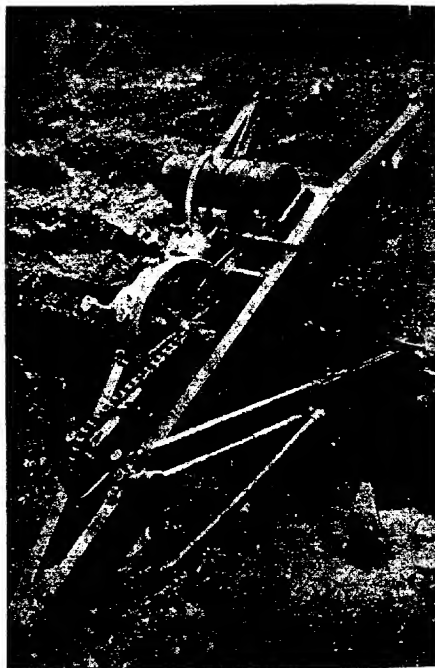
Fig. 4. — Vertical section of a dressing plate and feed channel.

Mode of action. — The dressing plates are put in motion by any suitable power. The grain to be dressed is introduced to the cylindrical feed channel *c* through a funnel or by similar means. Hence it passes to the plates by discharge orifices *r* under the influence of the rousing shaft *h*. The seeds roll over the dressing plates *t* which surround the channel *c* and

move quickly or slowly, according to their weight and shape, towards the channels *n* at the periphery of the plates. Perfectly round seeds roll quickly off the plate and reach the annular channel on the first carrier platform *p* and thence the first discharge channel. Seeds which are not round or those which are gnawed by worms roll slowly to the edge of the plate and only reach the second division of the annular channel passing out through the corresponding discharge orifice. Broken or damaged grain, husks, etc., slip rather than roll and only reach the third division and emerge by the last discharge opening. Debris (stalks, etc.), entangled in the grain, which is not carried to the sieve by the rousing shaft, is removed from the plates by the rotary brushes *m*.

1307 - The Elbert Vaughan Portable Saw driven by Petrol Motor, for Tree Felling (1).
The Scientific American, Vol. CXV, No. 11, p. 264. New York, September 1916.

The Elbert Vaughan portable saw is driven by a 3.5 HP, two-stroke petrol motor. The total weight of the machine is about 220 lbs. As shown



The Elbert Vaughan portable motor saw.

(1) See also *B. May* 1916, No. 350.

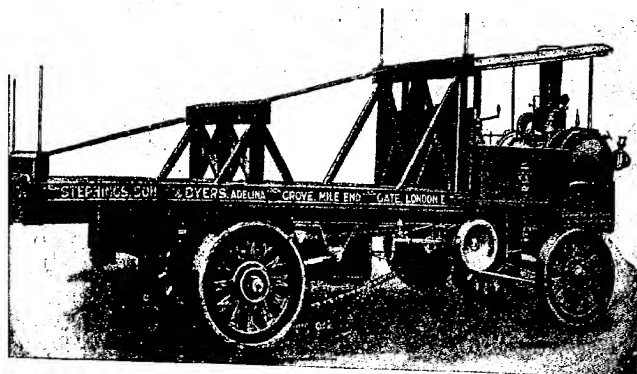
in the attached figure, the saw is mounted on a V-shaped frame of which the lower end rests on the ground while two clamps fix it solidly to the tree to be sawn. When a cut is finished the machine can be shifted by two men to the place where the next cut is to be made.

As an example of the work done by this portable saw in 10 hours, the writer gives :

Maximum	35 cords (4480 cub. ft.) of wood in billets of 4 feet.
Minimum	15 cords (1907 cub. ft.)
Average	20 cords (2546 cub. ft.)

308 - **Lorry for Transporting Timber in Long Lengths.** — *The Implements and Machinery Review*, Vol. 42, No. 498, p. 663. London, 1916.

The Yorkshire Commercial Motor Company of Leeds has built a lorry carrying 6 tons of wood in lengths up to 45 feet. Ordinary vehicles do not allow of the carriage of long pieces because of the limited platforms of the lorries and also on account of the unequal distribution of weight. To avoid



Lorry for transporting timber in long lengths.

these disadvantages the above company has fitted the chassis with two trestles of different heights; the rear trestle is lower than the forward trestle and fixed to the frame directly over the back axle; the forward trestle is fixed just behind the motor. The respective height of the two trestles allows long pieces to be sloped conveniently. This arrangement together with the well proportioned design, distributes the weight uniformly on the bearing points of the vehicle. Another advantage of this lorry is the relatively long platform compared with the space occupied by the steam generator and the machinery. The latter is of simple type, with large bearing surfaces, and is very well balanced. The generator and fire-box are of such dimensions that the tubes are always covered with water whatever the angle of tilt assumed by the lorry.

1309 - "Silicate Cotton" as Insulating Material for Boilers and Refrigerators.—SCOT JAMES, in *Ice and Cold Storage*, Vol. XIX, No. 221, pp. 103-104, 3 figures. London August, 1916.

The writer criticises the name "silicate cotton", as unsuitable, since the substance does not contain any cotton, and suggests "silicate fibre" as a substitute. It consists actually of a silicate, or rather of a mixture of calcium silicate with silicates of other bases. The material is prepared from blast furnace slag, more especially from the semi-transparent portion of a vitreous nature, and does not undergo any change on exposure to the air under ordinary conditions.

The slag is melted and a jet of steam blown through which divides the mass into an infinite number of small particles, of different shapes, containing air bubbles. One cubic foot of slag forms 12 cubic feet of silicate, which thus includes 11 cubic feet of air.

Besides being used for floorings as a noise absorbing agent, this material is employed for boiler laggings. It is now coming into use as an insulator for cold storage purposes as it has the advantage of being absolutely incombustible and non-fermentable, while from the thermal point of view it is one of the worst conductors known.

1310 - Review of Patents.

Tillage Implements.

Austria	72 056	Cultivator.
	72 058	Motor plough.
Canada	168 704	Hoe and cultivator combined.
	169 032	Multi-furrow plough.
	169 107	Drain plough.
	169 195	Tractor plough.
	169 269	Share-lift.
	169 364	Roller coupled to plough.
	169 372	Harrow.
	169 593	Hoe.
Germany	169 852	Method of fixing cultivator discs.
	292 096	Method of fixing the share to the frame, easily detached, especially for tractor ploughs.
	292 129	Spring connection for share of motor plough.
	292 130	Cultivator with rotating knives, with axis of rotation parallel with the line of work.
	292 181	Cultivator with vertical knife-bearing drums.
	292 411	Grips for motor plough and other wheels, with pieces situated on the plane of the axle.
	292 412	Chassis for reversible plough, working on the balance-plough principle.
	292 438	Tractor plough.
	292 439	Motor plough with fixed shares, adjustable for height by means of a rack.
	292 628	Device for fixing and unfixing ploughs coupled to the tractor chassis by means of a draw-bar.
	292 629	Plough furnished with frame detachable at side for tractor work.

	292 932	Disc-harrow with articulated axles.
	292 975	Motor plough of driven disc type.
	293 243	Motor plough with frame adjustable as regards height by mechanical power.
	293 408	Mole-plough.
Holland	1 590	Cultivator with rotating toothed drum.
Italy	153 252	Transverse connection for fore carriage.
	154 008	Motor plough with driver rotary blades.
	154 177	Motor plough for special soils.
	154 305	Improvements in ploughs.
United States	1 188 032 — 1 188 091 — 188 412 — 1 188 690. — 1 188 727	Cultivators.
	1 189 332 — 1 189 890	Harrow.
	1 189 365	Wheel plough.
	1 191 404	Spiral harrow.
	1 191 685	Plough coulter.
	1 191 850	Attachment for cultivator.
	1 194 087	Ploughing machine with rotating cylinder.
	1 194 166	Plough.

Drainage and irrigation.

Germany	292 155	Automatic device for sprinkling and irrigating with tipping receivers to control the valves.
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Fertilizers.

Canada	169 161 — 169 162 — 169 163	Process for fixing nitrogen.
	169 491	Process for calcium cyanamide manufacture.
Germany	291 227	Process and device for spreading fertilizers.
	292 440	Agitator and pump for liquid manure driven by electric motor.

Sowing and planting machines.

Austria	71 906	Drill with distributor discs inside the hopper.
Canada	170 148	Drill.
Germany	290 920	Garden drill.
Italy	153 484	Drill and manure spreader.
United States	1 189 019	Drill for Maize.

Plant diseases: prevention and remedies.

Austria	70 878	Method of protecting coniferous and other trees from rodents.
Germany	290 611	Process for making insecticide.
	291 810	Device for guarding vineyards and orchards against hail storms.
	292 270	Insecticide.
Italy	153 302	Insecticide for spraying.
	153 525	Improvement in continuous jet sprayers.
	153 761	New improved sprayer for blight and insects.

Harvesting and haymaking machinery.

Austria	70 085	System for converting mower to binder.
	70 512	Reaper.
	70 656	Reverse mechanism for driving-wheel of binder.

Canada	169 397	Rake.
	169 497	Sheaf-maker.
	170 404	Binder.
Denmark	21 364	Lawn mower.
	21 398	Self-binder.
Germany	291 682	Guard for mower running behind or at side of machine.
	291 699	Device for recovering grain and seed from self-binders
	291 715	Knot for balers, binders, etc.
	291 825	Machine for making cocks.
United Kingdom	6 768	Reaper.
	8 242	Horse rake.
United States	1 191 385	Gear for coupling hay rake to lift.
	1 194 788	Teeth for hay rake.
	1 195 320	Maize binder.

Machines for harvesting root crops.

Austria	71 879	Potato digger.
	71 902	Beet puller.
Canada	169 839	Potato digger.
France	480 359	Potato digger.
Germany	291 688	Device for raising the tines of potato digger.
	291 706	Seat for 2-wheeled potato digger.
	291 714	Topping machine for beets.
	292 372	Potato digger with projecting forks.
	94 473	Beet-puller fitted with endless belt transporter.
	292 740	Wheel with forks for potato digger.

Winnowing and threshing machines.

Canada	169 215	— 169 559	Threshing machine.
	169 253		Mechanism for threshing machine.
Italy	153 981		Improvement in machine for separating grain coated with mud clage from grain not so coated.

Transport, dressing and storage of crops.

Canada	168 597	Silage chopper.
	169 813	Hay lift.
Germany	292 442	Mechanism for clutching and de-clutching the feed of straw balers. (1)
	293 105	Binding device for straw-baler.
Italy	153 897	Folder trussing machine.
United Kingdom	5 894	Hay lift.
United States	1 191 105	Maize lift.
	1 192 056 — 1 192 307 — 1 194 179	Hay lifts.

Steering and traction of farm machinery.

Canada	168 223 — 168 224 — 168 439	Tractors.
Italy	151 049	Anti-skid device for tractor for difficult soils or heavy loads.

(1) See B. November 1916, N^o. 1200.

United States	1 191 333	Tractor motor.
	1 191 858 — 1 192 423	Tractors.
	1 193 776	Plough tractor.

Feeding of stock.

Austria	72 015	Feeding machine.
Germany	293 106	Feeding tray for fitting over manger.

Apiculture.

Italy	154 157	Improved hive.
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Manufacture of vegetable products.

Austria	70 902	Knecalling machine.
	169 334	Flax dressing.
	169 446	Desiccator for food cakes.
	169 345	Cereal food in strip form.
France	153 952	Desiccator for grain, seed and flint.

Dairy industry.

Austria	69 998	Draw-off tap for milking machine.
	71 109	Chain mechanism.
Canada	169 284	Pulsator for milking machine.
	169 285	Can-filling machine.
	170 146	Milk filter.
	170 425	Fat separator for creamery.

Miscellaneous.

Austria	70 255	Meat chopper.
	70 803	Country stove.
	70 815	Trocar.

1 - **Method of Housing Stock in Pens without Divisions in Use in Ohio, U. S. A.** — HYSTON G. L., in *Hoard's Dairyman*, Vol. LII, No. 6, p. 165, fig. Fort Atkinson, Wisc., September 1, 1916.

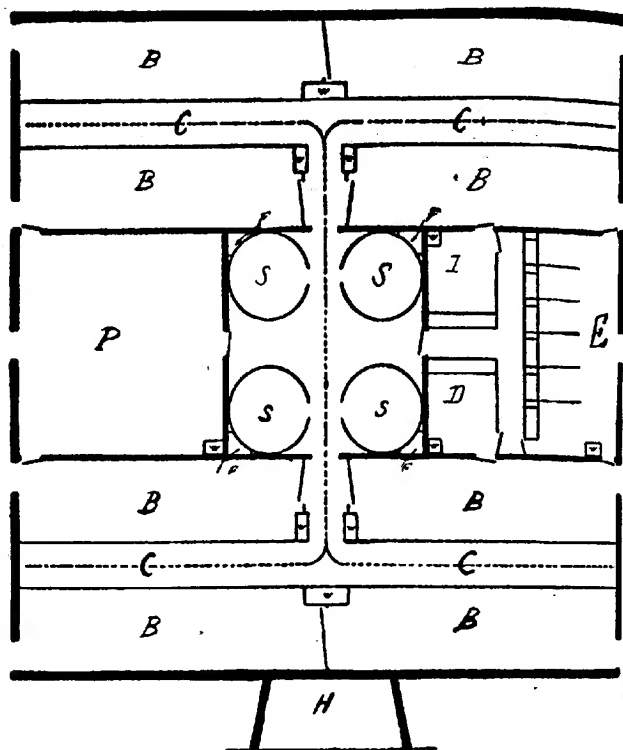
FARM
BUILDINGS

As shown in the accompanying figure, the stock building is divided into three parts: the cattle pens occupy the ends, while the silos, boxes, horse stables and a shed for fattening poultry are in the centre. The pens at each end form four compartments separated by the feeding passage, 4 feet wide, which also serves as a manger and is fitted with an overhead travelling skip for carrying the food. This skip, 3.7 × 4.2 feet in size, can carry from 1000 to 1200 lbs. of ensilage.

Barriers, moved by a lever, control the animals during feeding. The use of the feeding passages as mangers saves a space of 4 feet throughout the building that would normally be occupied by mangers. Feeding is thus more convenient and there is less waste.

The cattle pens measure 42 × 13 ft. without the feeding passage; the manger occupies 40 sq. ft. per animal. Each pen holds 13 cows (there is room for 16) or 16 bullocks. The floor of the pens and passages is of concrete. The platform on which the beasts stand when controlled by the bar-

riers is raised 6 inches above the floor level. Each pen receives 150 lb of straw daily, and when the manure is 1 foot deep, another 100 lbs. of straw is added. The bullocks receive their litter once, the cows twice a day, the second time at the evening milking. The writer states that with th



Plan of stock buildings with open pens at "West View Farm", Ohio.

- | | |
|---------------------|-----------------------------------|
| B = Cattle | P = Fattening Crates for Chickens |
| C = Feeding passage | W = Water |
| D = Box stall | E = Horse Stalls |
| S = Silo | F = Ventilating Flue |

system of housing there is less nuisance from milk than otherwise, and the animals are more comfortable. There is less labour for the men and the animals are quieter.

The 8 pens require 34 to 64 tons of straw for 6 months. The on

jection is the large amount of straw used, but the writer proposes to mix soil with the straw and intends to experiment with this next year.

The ventilation is on the "King" system which is according to theriter, most suitable for this kind of building.

RURAL ECONOMICS.

312 - **The Possibilities of Increased Crop Production.** — RUSSELL E. J., in *The Journal of the Board of Agriculture*, Vol. XXIII, No. 6, pp. 555-560. London, September 1916.

In his presidential address on 6th September, at Newcastle, to the Agricultural Section of the British Association, Dr. E. J. RUSSELL took as his subject the possibilities and prospects of increased crop production.

In the development of agricultural methods in England the three great areas of progress have been: a) the introduction, usually from Flanders, of crops that had not previously been grown on British farms, b) the removal of obstacles which prevented crops from making as full growth as they could, and c) the introduction of new methods for increasing the growth of the plant. The body of the address was devoted to a consideration of means of i) increasing the yields per acre, and ii) reducing the cost of production and increasing the certainty of production.

Increased yields per acre. The main obstacles to increased plant-growth are in the climate and in the soil. Climate apparently cannot be altered; before crops and varieties suited to conditions must be grown. Soil can be altered, and it is possible to do a good deal in the way of changing it to the crops that are wanted. Light soils, clays and loams were each considered by Dr. Russell.

On *light* soil the two great obstacles to be overcome are the lack of water and the poverty in plant nutrients. The problem can be dealt with by increasing the depth of soil through which the roots can range, or by adding the necessary colloidal substances, clay, marl, or organic matter. The addition of organic matter must generally be accompanied by the addition of lime or potash and all the plant nutrients — nitrogen, potash and phosphates — as well as by constant cultivation to keep down weeds and retain soil moisture. When all this is done, light soils become very productive; but on account of the costs of the above processes, crops must be grown which bring in a high net return — potatoes, greens, peas, sugar-beet, or two crops in a season.

The best hope for improvement of light soil lies in increasing the number of early-maturing crops, improving the methods of growing them and the relation of the other crops, or the live stock, and improving the organization for the raising of them, so that farmers will feel justified in spending the rather considerable sums of money without which these light soils cannot be successfully managed.

Heavy land can be improved by liming or chalking followed by drainage. Drainage promises to be an efficient and much cheaper substitute for the old system of draining, but co-ordination and a certain

control over the whole drainage area is needed, it being undesirable that a great fundamental improvement should be at the mercy of individuals.

The cultivation of clay land is always risky however, as it is suited only to a limited number of crops, and is difficult to cultivate, and hence most men lay down this land to permanent grass. This risk can be reduced:

a) by quicker ploughing in autumn so as to bring the work we forward; this seems only possible by the use of the motor plough. Dr. Russell believes that motor ploughs and cultivating implements will play a considerable part in the improvement of heavy land;

b) by keeping up the supplies of organic matter in the soil; the simplest plan seems to be the adoption of the North Country system, in which the land is alternately in grass and in tillage. Dr. Russell thinks that demonstrations on such lines, in heavy land districts, would resolve many of the farmers' doubts as to the advisability of breaking up some of the grass land.

Loams present no special difficulties. The crop may be hampered by lack of root room, in which case periodical deep ploughing or subsoiling may bring about a substantial improvement; subsoiling at Rothamsted at a cost of about £1 per acre was followed by an increased yield per acre of 10 cwt. of potatoes worth 35 s.

All the above soils can next be further improved by proper treatment with fertilisers. Dr. Russell anticipates considerable improvements from closer co-ordination of crop variety and soil and climatic conditions.

Reduction of Cost per Acre and Increase of Certainty of Production. One of the most hopeful ways of attacking this problem is to increase the efficiency of the manurial treatment; the whole of the fertilising constituents applied to the soil are never recovered in the crops but by arranging a proper rotation, and by using a properly balanced manure the loss can be much reduced. As regards this latter point Dr. Russell pleads for agreement between the county authorities as to a uniform scheme in their manure experiments. Economy is also possible in the management of farmyard manure, the production of which is estimated at 37 million tons annually valued at £9 250 000, compared with an annual consumption of £6 500 000 worth of artificials.

Further saving is possible in the soil itself; where there is no crop there is a loss of valuable nitrates over the winter, the heaviest loss occurring on the best manured land. This emphasises the need for spring dressings of quick-acting nitrogenous manures, and accounts for the marked improvements that are set in on many soils when spring dressings are given. A good way of getting round the difficulty is to sow a catch crop in autumn and either to plough it in before the main crop is sown, or to feed it to stock whichever is more convenient. Leaving arable land in grass for a few years the gain in nitrogen during this period, may balance the loss during the arable period; this has already been done in several rotations, but it suffers from the disadvantage that the land during its recuperative grass period is producing less than during the arable period. Dr. Russell next dealt with the improvement possible in

ration, which will result from the use of the motor plough, or tractor, and alluded finally to economy in the choice of crops.

The need for accounts was emphasised, as enabling unprofitable crops be replaced by profitable. *Swedes* e.g. are invariably grown at a loss at Othamsted and Dr. Russell believes this would be found not uncommon in the south of England. The survey of the methods of increasing crop production was concluded by a reference to the need to raise by educational methods, the ordinary farmer to the level of the good one, to the need for extending the area of land under cultivation, by the reclamation of wastes, and to the need for the substitution of arable for grass.

Lastly, there is a factor which operates against increased crop production which Dr. Russell thinks it unreasonable to hope to see entirely abolished, and that is that a farmer has to get his pleasure out of the countryside, as well as find his work in it, so that trees, hedges and spaces are left, pheasants bred, foxes and hares preserved and rabbits reared.

"When we know more about the soil, the animal, the plant, etc, we shall be able to increase our crop-yields", says Dr Russell, "but we shall lose the best of our work if we put the crop-yield first. Our aim should be to gain knowledge that will form the basis of a true rural education, so that we may train up a race of men and woman who are alive to the beauties and the manifold interests of the countryside, and who can find there the satisfaction of their intellectual as well as their material wants. If we can succeed in that, we shall hear far less of rural depopulation; instead we may hope for the extension of that type of keen healthy countryman, which has always been found among the squires, farmers, and laborers of this country, and which we believe was already increasing before the War. With such men and women we can look forward with full confidence to the future.

3 - Comparative Results obtained on an Estate in Tuscany where a Farm Worked by the Landlord was Afterwards Run on the Metayage System. — BRINT F., in *L'Agricoltura Italiana*, Year XLIII, pp. 100-104. Pisa, July-August 1916.

The Magognana farm at Poggibonsi, Tuscany is a holding of 10.87 hectares (27 acres) (1) of which 1.27 hectares is occupied by buildings, roads, etc., and 1.2 hectares by vineyards, leaving an area of 8.6 hectares for the arable fields. The holding used to be farmed on the landlord's account and under that management it was worked on a 9-years rotation, but when later the land was transferred to a metayer, a 4-course rotation was adopted at the same time.

The two rotations and the net returns per hectare under both systems are given below.

(1) 1 hectare = 2.47 acres.

I. *When under landlord :*

	Lire
1st year: Maize with bean	32
2nd " Wheat with clover seeds	61
3rd " Clover	116
4th " Wheat	61
5th " Beans	73
6th " Wheat with lucerne or sainfoin	61
7th " Lucerne or sainfoin	103
8th " " " "	130
9th " Wheat, stubble grazed in autumn	61
Total	718

* net return per hectare per annum 80 lire.

II. *When under metayage :*

	Total net returns — Lire	Landlord's share — Lire	Metayer's share — Lire
1st year: Maize with beans and grazing previous autumn	249	185	64
2nd " Wheat with clover seeds	131	60	71
3rs " Clover	162	38	124
4th " Wheat	131	60	71
One fifth of total area always kept on lucerne	453	208	245
Total	1126	551	575
* net return per hectare per annum	225	110	115

Difference between two systems :

Per hectare :	Total net returns — Lire	Landlord's share — Lire	Metayer's share — Lire
under system II	225	110	115
" " I	80	80	—
Difference	145	30	115

On the whole farm (8.6 hectares) :

under system II	1937	938	999
" " I	686	686	—
Difference	1251	252	999

No similar comparison can be drawn with regard to the returns from the vineyard, as the vines were newly planted and the conditions therefore not comparable in the two periods. But according to observations made on other vineyards worked first under the one system and then under the other it is probable that the yield of wine was increased by between 2 and 3 quintals by the more careful management of the metayer who has a more personal interest in the welfare of the vines than the day labourer. Even by valuing the increased returns as low as 50 lire per hectare, the net returns of the holding amount to 2000 lire per annum or to 1313 lire more than when it was run on the landlord's account.

114 - **Metayage on an Umbrian Estate (Italy).** — PAPI C., in *L'Italia Agricola*, Year, 59, No. 8, pp. 333-363. Piacenza, August, 15, 1916.

On the Casalina Estate belonging to the Perugia Agricultural Institute study was made of labour in its relation to different classes of land. The estate is situated in the Middle Valley of the Tiber, between Perugia and Viterbo, and covers an area of 1557 hectares (1) made up of :

750	hectares of drift or alluvial soils in the valley (loams)
700	" " sedimentary soils on the hillsides (clay or pebbly sand)
105	" " sedimentary soils, on the mountain side (shingle).

Considering the estate from the point of view of cropping it may be divided into :

896	hectares of arable land planted with rows of plane trees and vines every 25 to 30 metres; situated on the flat or on gentle slopes where mowing and reaping machinery can well be used; divided into 36 holdings of 18 to 40 hectares each, held by metayers.
255	" of arable land planted in vines and olives on the hillsides where horse tillage can be employed but where harvesting machinery cannot be used; divided into 19 holdings of 10 to 18 hectares each and one holding of 37 hectares all held by metayers.
13	" of special crops (vines, olives, mulberries, nurseries) partly cultivated by the estate and partly worked on a system of metayage with the metayers of the other parts of the estate or with labourers from the town of Casalina
30	" of permanent grass and of poplar and willow plantations.
363	" of oak and cherry woods on the hillsides and mountains. All forestry work is undertaken by the estate whilst the grazings are in the hands of metayers.

On all the arable land, it is estimated that the permanent crop (*i. e.* vines, olives, etc.) occupies one fifth of the area and that the rest is divided equally between corn and forage crops. Table I gives the value of the average production per hectare of both crops and stock during the three years 1912-1914.

The returns are very low when compared with those obtained on the best farms of Central Italy, but in order to develop the estate properly it will be necessary to regulate the course of the Tiber which at present does considerable damage to the low-lying land. On the hillsides, noticeable improvements have already been carried out though high yields can never be expected owing to the nature of the soil. The profits on live stock are higher on the hill zone than on the low ground chiefly because in the former no account is taken of the grazing provided by the woods. In Table II is set out the head of live stock and its distribution between high and lowland holdings.

At Casalina, the system of metayage in force is a good example of the custom of partnership with equal shares: the land, buildings, live and dead stock belong to the landlord; the smaller implements are mostly pro-

(1) 1 hectare = 2.47 acres.

TABLE I. — *Value per hectare of produce from crops and stock, 1912-1914.*

	1912	1913	1914	Mean
	Lire (1)	Lire	Lire	Lire
<i>Lowland zone (896 hectares):</i>				
Value of field crops not consumed on the holding	250	220	216	229
Value of crops from plantations (almost entirely vines)	59	38	57	50
Net profits on live stock	36	46	72	51
<i>Hill zone (255 hectares):</i>				
Value of field crops	147	133	140	140
Value of crops from plantations (vines and olives trees)	83	60	59	67
Net profits on live stock	79	59	99	77

(1) 1 lire = 9 $\frac{1}{2}$ d.

vided by the tenant; all produce from field crops or trees and all losses (gains on the live stock are divided equally between landlord and tenant all expenditure on seeds, manures, fungicides, live stock taxes, insurance veterinary fees, blacksmith, are also divided equally between the landlord and tenant; the land tax is paid by the landlord and the income tax by the tenant; the house and garden are the exclusive property of the tenant and so are the poultry, but the landlord makes some fixed rent charge for the latter. Such a system as this with slight modifications is adopted throughout Umbria.

Table III summarises the data dealing with the metayers and their families on the Casalina estate and distinguishes between the workers and the consumers according to the classification suggested by FAIRA (1). In Table IV the supplementary casual labour employed by the metayer during the years 1912-1914 is given. For the corn harvest, which is the work requiring most labour, it has been estimated that in normal times an additional 1960 men-days and 600 women-days are necessary, or assuming that the harvest lasts 12 days, an extra 163 men and 50 women would be employed on the land.

In calculating the proportion of workers in the metayer families, women, old men and children are assigned values varying from 3 tenths to

(1) Cf. *Nuova Antologia*, May 16, 1915: Earnings and food consumption of metayers. Investigations on the earnings and food consumption of the metayers at Casalina have been made by the students of the Perugia Agricultural Institute.

TABLE II. — *Live stock on the estate, December 31, 1914.*

	Mean live weight per head	Total head	Total live weight	Total head per hectare	Total live weight per hectare
	Quintals (2)		Quintals		Quintals
<i>Lowland zone (36 farms):</i>					
Bulls	10	1	40	0.3	2.3
Bullocks (working)	9	110	990		
Cows	7	93	651		
Calves	1	32	32		
Yearling cattle	5.5	69	380	0.1	0.4
Mares	5.5	40	220		
Foals	3	43	129		
Asses	2	2	4		
Pigs	—	454	—	0.5	—
Sheep	—	138	—	0.2	—
<i>Hill zone (20 farms):</i>					
Bullocks (working)	8	48	384	0.3	2.0
Cows	6	10	60		
Calves	1	4	4		
Yearling cattle	5	14	70		
Mares	5	9	45	0.1	0.4
Foals	3	14	42		
Asses	2	3	6		
Pigs	—	237	—	0.9	—
Sheep	—	211	—	0.8	—

(2) 1 quintal = 220.5 lbs.

tenths of the normal man-day. The writer points out that the chief characteristic of the system of metayage is its remarkable elasticity with regard to supplying labour. For instance at the present time when 20 per cent of the men are away, the harvest was nevertheless carried out by the families of the metayers with the help of only an additional 80 people from the town of Casalina. This fact has suggested the possibility that up to the present the labour of the metayers and their families has not been used to the best advantage. That the subdivision of holdings — a process with which the growth of intensive farming was thought to be intimately connected owing to the consequent increase of labour in the form of metayage — may not be an economical procedure beyond a certain point, partly because it means

TABLE III. — *Composition of the metayer families.*

	Whole estate	Lowland zone	Hill zone
Total number of families	56	36	20
Total number of individuals	810	614	196
Males	433	329	104
Females	377	285	92
Males under 10 years	314	243	71
Females	260	191	69
Workers	382	294	88
Consumers	680	513	167
Mean composition of one family {			
Males	7.7	9.1	5.2
Females	6.7	7.9	4.6
Workers	6.8	8.2	4.4
Consumers	12.2	14.3	8.4
Per hectare of arable land {			
Total number of individuals . .	0.7	0.7	0.7
Workers	0.3	0.3	0.3
Consumers	0.6	0.6	0.6
Number of individuals absent temporarily	92	70	22

TABLE IV. — *Casual labour employed by metayers, average of three years (1912-1914).*

	Men	Women
	days	days
May	770	170
June	930	210
July	1 700	370
August	395	88
September	230	52
October	700	150
November	70	20
	4 795	1 060
Average per hectare over whole period {		
lowland zone	4.4	0.9
hill zone	3.3	1.0

the sinking of capital and partly because it raises the price of labour and limits the use of farm machinery. It would appear that the best results might be obtained by a combination of metayage and casual labour, where the holdings are large enough and remunerative enough to employ a certain amount of outside labour for which a fair price could be paid.

¹³¹⁵ - Government Share-Farming Experiment in New South Wales, in *The North British Agriculturist*; Vol. LXVIII, No 38, pp. 579. Edinburgh, September 21st 1916.

The Government of New South Wales has just entered upon an experiment in share-farming on the Forest Vale Estate of 20,000 acres between Nyalong and Lake Cudghecho. The homestead block of 1500 acres is to be used as an experimental farm, under the control of the Department of Agriculture. The balance of the area has been subdivided into twenty farms of about 800 acres each, which it is intended to apportion out, on the new system between as many applicants should as many as twenty be forthcoming.

The farms, although meant to be run on a profit-sharing basis, will be kept strictly under control as regards methods of working. Thus of the 800 acres, 500 acres must be used for cultivation purposes the remainder being devoted to grazing. Again of the 500 arable acres, 250 must be sown each year and 250 acres fallowed. Ten acres must be ploughed and planted for afforestation purposes. Sheep should be run on each block, and assistance may be given regarding the purchase of these sheep. The share-farmer is to find his own equipment for putting in and taking off the crop, to find his share of the bags and to pay for his share of the cartage. The share-farmer is to have two-thirds of the whole of the crop, whether cut for hay or stripped for grain. For the 550 acres (about) of grazing and fallowed land the farmer will pay to the crown rental at the rate of 2 1/2 per cent on the improved capital value. The Government's share will be one-third of the crop, and the Government will find its own share of the bags pay its share of the cartage and find the whole of the manure necessary for the cultivation area. Houses will be built for the settlers who will be consulted regarding details. The land will be cleared and fenced, and a store will be established. A saw-mill will be provided in a central situation, and about three-quarters of a million feet of timber will be set on the property for houses, sheds etc. There are various other minor conditions, and it is provided that the whole will be embodied in a contract of lease between the parties and the Government. Applicants in applying for farms must state whether they are natural born or naturalised British subjects; whether married or single; the extent of practical farming experience already possessed; the amount of capital on hand, and other such like particulars.

¹⁶ - The Examination and Interpretation of Data in Investigations on Agricultural Economics. — MARENGHI E., in *L'Eco degli ingegneri e periti agrimensori*, Year XX, Nos. 6 to 16, pp. 61, 76, 85, 97, 111, 122, 135, 160, 178, 181. Peschia, March to August 1916.

Many investigations in agricultural economics are based on data drawn from various sources and unless these are subjected to a critical examination

before being used, they can lead to very erroneous conclusions. The present paper deals solely with methods of testing data and with the means adopted for making them more reliable.

Data collected from different sources are not always comparable and in order to check such figures it is often possible to make use of calculated values drawn from a single secondary source. For instance, in order to check the data on the production of forage crops in 27 districts of the Province of Rome (1), the unit consumption was worked out for each district (Table I) from the weight of live stock maintained and the amount of fodder required to feed a unit weight of live stock per annum, assuming that it takes 12 parts of hay or hay equivalents to maintain 1 part of live weight for 1 year. There is little agreement between the two sets of figures, showing that the returns for the forage crops, or for the live stock or for both were unreliable. Some sources of error there must always be even in the most careful records of this kind, but they should not be of an order to suppress all correlation between the two sets of returns. Assuming that the live stock returns are more likely to be correct than the forage returns, it follows that the latter should only be used with caution.

Another method of checking the reliability of data is based on the fact that there should be some sort of order connected with the chronological sequence. For example in Tables II and III, data are set out representing the production of olive trees and vines over the period of their growth, the data being collected by various investigators and in different parts of Italy. When plotted, the data give rise to very irregular curves which are a direct proof of errors in the returns, as except in cases where considerable modifications take place in the treatment of the plantations or where a disease appears, the average yield from such permanent crops should give a fairly smooth curve.

Ordinary statistical returns collected by the Government are often very imperfect. During the Enquiry into the conditions of the agriculture population in the south of Italy, it became apparent that the data on the numbers of metayers, farmers, etc., published in the population census were almost useless. A confusion had been caused by the bad wording of the schedules on which the returns were collected, the various classes of holder not being sufficiently well defined, so that under the group metayage were entered not only the various kinds of tenant partnerships, but also ordinary tenant farmers and other types of tenancies.

Besides testing the reliability of data, a critical examination often indicates a means of improving them and of smoothing out curves by the use of arithmetic, algebraic or graphic methods (2). By thus eliminating oscillations due to incidental causes the general trend of the phenomena under discussion is more clearly defined. The use of arithmetic methods is particularly adapted to chronological series where the irregularities are

(1) *Ministero di Agricoltura, Industria e Commercio, Ufficio di Statistica agraria, Censuario del Regno d'Italia*, Vol. VI, No. 3, Part 2, pp. 11-65. Rome 1916.

(2) See R. 1914, No. 845.

TABLE I. — *Production of dry fodder per hectare in the Province of Rome.*

	District	Production of dry fodder per hectare		Weight of livestock per hectare
		From crop returns	Calculated from livestock returns	
		Quintals	Quintals	Quintals
1	Volsian Hills	7.60	7.92	0.66
2	Lake of Bolsena	5.20	8.40	0.70
3	Bognorea Hills	8.70	9.60	0.80
4	Orte and Civitacastellana	7.10	7.32	0.61
5	Soracte	6.20	10.68	0.89
6	Viterbo	5.70	6.72	0.56
7	Cimini	4.70	7.32	0.61
8	Maremma (inland)	6.40	9.60	0.80
9	Vetralla	5.20	8.28	0.69
10	Maremma (coast)	5.20	9.48	0.79
11	Civitavecchia	8.10	11.76	0.98
12	Lake of Bracciano	7.80	11.16	0.93
13-16	Agro Romano (3 districts)	13.80	12.96	1.08
17	Anzio and Nettuno	7.60	7.80	0.65
18	Upper Valley of the Anio	5.80	9.12	0.76
19	Valley of the Tiber	8.50	11.04	0.92
20	Pretestina	4.00	8.04	0.67
21	Alban Hills	4.70	11.88	0.99
22	Simbruini Hills	5.90	6.12	0.51
23	Velletri and San Palfano	4.50	13.92	1.16
24	Val Sacco	6.00	18.00	1.50
25	Lepini Hills	5.40	9.24	0.77
26	Ausoni Hills	6.40	11.16	0.93
27	Pontine Marshes	7.20	13.80	1.15

is not so much to the way the returns are collected as to incidental causes. In the series of figures dealing with the production of a vineyard during the early years of its life (series *A*, Table IV), there is some anomaly in the figures for the seventh to the tenth years. By using Winstein's method of determining the means of 3 terms, the series *B* is obtained, which is far more regular. Or by applying the algebraic method, i. e. interpolating a parabola the second order according to the method of the least squares, the series is obtained. The geometric or graphic method also gives good results. This method consists in representing the actual figures by a Cartesian diagram and in interpolating in it a curve which approaches the same series.

TABLE II. — *Production of vines (chronological series).*

In rows, wide apart, on cultivated fields						In vineyards					
Bologna district (CANEVAZZI)		Central Italy (MONTI)		Terra di lavoro (MUZZI)		Abruzzi (MUZZI)		Apulia (FLORES)		Sicily (BRUTTINI)	
Age	Mean yield of grapes per 100 hills	Age	Mean yield of grapes per 100 hills	Age	Mean yield of grapes per 100 hills	Age	Mean yield of grapes per 100 hills	Age	Mean yield of grapes per 100 hills	Age	Mean yield of grapes per 100 hills
Years	Kgs.	Years	Kgs.	Years	Kgs.	Years	Kgs.	Years	Kgs.	Years	Kgs.
0 to 10	—	0 to 16	—	0 to 6	—	0 to 5	—	0 to 3	—	0 to 4	—
11 » 20	150	17 » 30	1090	7 » 10	900	6 » 15	45	4 » 8	26	5 » 14	40
21 » 25	856	31 » 60	1500	11 » 15	2700	16 » 25	100	9 » 13	32	15 » 24	60
26 » 35	1612	61 » 70	1310	16 » 30	4500	26 » 35	35	14 » 28	49	25 » 34	65
36 » 55	2092	71 » 80	1010	31 » 35	3000	36 » 50	25	29 » 34	35	35 » 44	52
56 » 80	1660	—	—	36 » 42	1800	—	—	35 » 38	—	45 » 55	38
—	—	—	—	43 » 60	2700	—	—	38 » 40	25	—	—

(1) Old vines replaced by runners at 40 years with a consequent increase of production.

TABLE III. — *Production of olive trees (chronological series).*

Pisani Hills (GUERRI)		Umbria (MONTI)		Provincia di Bari (SOMMA)		Territory of Gallipoli (MUZZI)	
Age	Mean yield per tree	Age	Mean yield per tree	Age	Mean yield per tree	Age	Mean yield per tree
Years	Kgs.	Years	Kgs.	Years	Kgs.	Years	Kgs.
0 to 10	—	0 to 12	—	0 to 14	—	0 to 12	—
11 » 16	0.67	13 » 30	0.46	15 » 20	0.56	13	3.63
17 » 21	0.78	31 » 50	0.87	21 » 30	1.27	15	4.32
22 » 26	0.95	51 » 200	1.13	31 » 40	2.40	21	6.40
27 » 31	1.11	—	—	41 » 50	2.50	25	7.78
32 » 36	1.33	—	—	51 » 60	3.90	31	10.03
Above 36	1.44	—	—	61 » 70	4.80	35	11.41
—	—	—	—	71 » 80	5.55	41	13.65
—	—	—	—	81 » 90	5.85	45	15.04
—	—	—	—	—	—	51	17.29

The values of the ordinates corresponding to the theoretical curve are the determined according to scale.

Grouping data in fairly large classes is another method of obtaining satisfactory approximations. Returns for the regional production of wheat

TABLE IV. — *Data treated by the arithmetic and the algebraic methods production of a vineyard in quintals per hectare.*

Age of vineyard in years	5	6	7	8	9	10	11
Figures actually recorded . . .	7.50	8.15	7.90	9.00	9.65	9.40	10.30
" treated arithmetically . . .	7.50	7.85	8.35	8.85	9.35	9.78	10.30
" algebraically . . .	6.86	7.44	8.10	8.84	9.16	10.66	11.54

TABLE V. — *Average earnings of metayers in Central Italy per "man unit" per annum.*

Locality	Authority	No of estates studied	Earning per "man unit" per annum		
			Maximum	Minimum	Mean
			Lire	Lire	Lire
any	MAZZINI (1) . . .	14	310	200	282
"	LEFARI (2) . . .	51	479	139	256
"	BRUTTINI (3) . . .	21	525	177	283
" { Val d'Elsa . . .		31	641	356	485
any { Val d'Arno . . .	GUICCIARDINI (4) .	19	642	360	489
{ Pistoian Hills . .		18	539	320	396
mbria (S. Venanzio) { 1913 . .	FAINA (5) . . .	9	639	123	336
{ 1914 . .		9	605	142	348
mbria (Middle Tiber Valley) .	BINDOCCHI (6) . . .	52	771	131	407
arches (Pesaro)	NIOLETTI (7) . . .	40	480	51	160

(1) *Atti della Giunta per l'inchiesta Agraria*, Vol. III, No. 1, p. 470.(2) *L'Agricoltura Italiana*, 1902, No. 12.(3) *Bollettino della Società degli Agricoltori Italiani*, Aug. 31, 1905.(4) *Nuova Antologia*, April 16, 1907.(5) *Id.* March 16, 1905. — According to this authority: 1 adult man = 1 man unit, and 1 adult woman = $\frac{8}{10}$ man unit.

(6) "Il guadagno del mezzadro nella media Valle del Tevere". Perugia, 1916.

(7) *Bollettino dell'emigrazione*, 1909, No. 29.

Italy (1909) proved satisfactory because the areas involved were large, and returns collected on the old method of small areas are open to criticism.

The homogeneity of data is a fair indication of their reliability and consequently has a marked influence on the correctness of the conclusions drawn from them. As an illustration of the necessity of a preliminary enquiry into the homogeneity of data before using them as terms of comparison, the

earnings of metayers in Central Italy are collected from various authorities and set out in Table V. If the object were to show the average earnings per man under the metayage system in different parts of Central Italy, the figure would not be comparable for in working out the available labour in each group and reducing to "men units", the factors employed were not constant. But if the object were merely to show the relationship between the earnings and the general fertility of the holdings the figures might be taken as comparable. The Table shows a very large range of variation in the earnings of metayers, for the metayage contracts tend to remain the same even in districts where yields differ markedly.

The homogeneity of the data must therefore be subordinated to the object in view. If, for instance, the yield of wheat per unit is being considered in countries which differ in regard to climate or other physical conditions, the data may be looked upon as homogeneous and therefore comparable if it is a question of showing that the phenomenon is a variable one. On the other hand the data will not be homogeneous if it is a question of appraising the values of the different systems of cultivation, for the yield does not only depend on the skill of the farmer but also on the general physical conditions of the surroundings.

Errors of judgment of the kind are frequently committed especially in dealing with questions of deforestation. The returns under a permanent system of forest management are compared with those which could be obtained by farm crops, no account being taken of the fact that the latter may only be transitory and grown at the expense of the accumulated capital in the land. Other examples of the same kind are the comparison of the wealth of nations or individuals under different conditions of locality or time or the comparison of wages when the economic conditions are not the same, etc.

Passing on to the methods of classification, grading and comparison employed in the interpretation of data and to Galton's index of correlation it is pointed out that the statistical study of agricultural problems will only reveal gross influences at work, for any one mass of facts whatever its nature is connected with a number of others and expresses therefore the result of the action of an indefinite number of variable factors. The correlation was determined between the yields of lucerne and the rainfall (Table VII) from data collected by the Agricultural Institute at Perugia. According to the formula (1).

$$\text{Coefficient of correlation, } r = \frac{14893.60}{\sqrt{13584.33 \times 75240.40}} = 0.40.$$

or in other words, the yields of lucerne are largely controlled by the spring

$$(1) \text{ Coefficient of correlation, } r = \frac{\sum(xy)}{\sqrt{\sum(x^2) \sum(y^2)}}$$

where x and y are the mean deviations in each series when the deviations are static. In cases where they are dynamic the above deviations are replaced by the difference between each effective term and the corresponding term of the normal curve which is plotted by a special process of interpolation.

ainfall. Again LENOIR (1) has worked out the coefficient of correlation between the production and the price of wheat in France with the following results:

From 1847 to 1870 the coefficient of correlation	was	...	0.75
" 1871 " 1885 "	"	"	0.56
" 1885 " 1905 "	"	"	0.34

showing that as the cereal market tends to become world wide, so the influence of the home production on prices tends to diminish.

With regard to the interpretation of agricultural experiments, it should be borne in mind that they hardly ever manage to isolate the action of the factors under investigation, for the experiments usually deal with plants and animals whose functions do not lend themselves to study under rigidly homogeneous conditions. As a case in point the probable error (2) was worked out for two of Wagner's series of results dealing with manurial experiments. (Table VIII). The mean increase in yield with nitrate of soda is 6.4 kg., while the probable error is 0.66 showing that the increase is due to the manuring and not to incidental causes.

From another set of results Wagner estimates the mean relative efficiency of ammonia nitrogen (nitrate nitrogen being taken as 100), from series showing considerable variation as follows:

	Relative efficiency	
	Mean	Highest and lowest figures
Wheat	87	13 to 107
Rye	76	52 " 109
Barley	72	42 " 109
Oats	90	61 " 121

These figures were worked out by GREGOIRE (3), taking into account the unit price of the two manures, and the results are given in Table VIII, from which it is much easier to judge of relative economic advantages of the two forms of nitrogen.

The probable error is also employed to determine:

1) The minimum amount of data required for the statistical study of a problem, using the formula $n = \varphi^2/E^2$ which is obtained from that of the probable error (E) and from the mean of a series of terms $E = \varphi/n$ where φ = probable error of each term and n = number of terms:

(1) M. LENOIR. *Etude sur la formation des prix*. Paris, 1913.

$$(2) \text{ Probable error, } E = 0.48 \left\{ \sqrt{\frac{2 \sum (d_1^2)}{n_1(n_1-1)}} + \frac{2 \sum (d_2^2)}{n_2(n_2-1)} \right\}$$

where $\sum (d_1^2)$ and $\sum (d_2^2)$ are the sum of the deviations squared and n_1, n_2 are the number of terms.

(3) A. GREGOIRE, *Les recherches agronomiques et l'interprétation de leurs résultats. Annales de Gembloux* 1912, pp. 52-58.

TABLE VI. — *Correlation between rainfall and yield of Lucerne.*

Year	Spring rainfall mm.	Deviation from the mean		Annual yield of lucerne per hectare Quintals	Deviation from the mean		Product of deviations (xy)
		Simple	Squared		Simple	Squared	
		(x)	(x ²)		(y)	(y ²)	
1903	209	— 21.6	466.56	150.90	+ 40.35	1 628.12	— 87.89
1904	118	— 112.6	12 678.76	142.70	+ 32.15	1 033.61	— 3 620.00
1905	345	+ 114.4	13 087.36	168.20	+ 56.65	3 208.32	+ 6 595.11
1906	299	+ 68.4	4 678.56	109.80	— 0.75	0.56	+ 51.39
1907	212	— 98.6	8 721.96	123.56	+ 13.01	143.26	— 241.99
1908	132	— 178.6	31 896.96	102.80	— 7.75	60.06	+ 70 136.01
1909	109	— 201.6	40 642.56	60.57	— 49.98	2 498.00	+ 6 077.55
1910	342	+ 111.4	12 369.96	79.00	— 31.55	995.40	+ 3 514.40
1911	220	— 10.6	112.36	48.00	— 62.55	3 812.50	— 669.20
1912	320	+ 89.4	7 992.36	120.00	— 9.45	89.30	+ 944.80
Mean 230.6		$\Sigma (x^2) = 75 240.40$		Mean 110.55	$\Sigma (y^2) = 13 584.33$		$\Sigma (xy) = 14 893.80$

TABLE VII. — *Manurial trials with nitrate of soda ; probable error of results*

	Unmanured plots			Manured plots		
	Production Kgs.	Deviation from the mean		Production Kgs.	Deviation from the mean	
		Simple (d ₁)	Squared (d ₁ ²)		Simple (d ₂)	Squared (d ₂ ²)
	20.1	+ 0.6	0.36	26.2	+ 0.3	0.09
	20.3	+ 0.8	0.64	26.9	+ 1.0	1.00
	18.7	— 0.8	0.64	23.3	— 2.6	6.76
	18.9	— 0.6	0.36	27.1	+ 1.2	1.44
Totals	78.0	—	2.00	103.5	—	9.29
Means	19.5	—	0.50	25.86	—	2.32
$Ed = 0.48 \sqrt{\frac{2 \times 2}{4 \times 3} + \frac{2 \times 9.29}{4 \times 3}} = 0.66$						

2) The best size for experimental plots. In this connection the result of LARSEN in Sweden may be cited :

Size of plot	Probable error
1/16 are (1)	16.7 per cent of the mean
1/8 " "	10.7 " "
1/4 " "	6.8 " "
1/2 " "	4.5 " "
1 " "	3.7 " "

(1) 1 are = 0.025 acres.

TABLE VIII. — *Relative efficiency of ammonia nitrogen and nitrate nitrogen as worked out by Grégoire.*

Crops	No. of experiments	Percentage probability of obtaining better returns from nitrate nitrogen than from ammonia nitrogen when the price of nitrate nitrogen is taken as 100 and the relative price of ammonia nitrogen is:							
		50	60	70	80	90	100	110	120
		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Wheat	25	24	28	36	52	68	92	96	96
Oats	58	10	22	36	53	76	86	90	95
Maize	30	3	7	23	27	27	70	87	90
Barley	51	20	31	43	61	76	90	94	96
Potatoes	25	8	8	12	28	48	72	80	88
Sugar beet	40	25	30	45	60	75	92	95	100
Langolds	48	23	40	62	81	92	98	100	100

These results, which have been confirmed by other authorities, show that the probable error decreases as the size of the plot increases, but not proportionately so that in practice it is usual to adopt unit areas not larger than 100 sq. metres, for with bigger plots, it becomes increasingly difficult to find a suitable experimental area where the soil shows no variability.

3) The appropriate size of samples for analysis. *RODEWALD* has shown: a) that for seed samples, 300 to 400 seeds are required for purity and germination tests, the error diminishing rapidly up to this point and then very slowly above it; and that the "error of tolerance" to be adopted is 2.22 per cent for seeds with a purity and germination capacity of 95 per cent. He also confirms *NOBLE's* conclusions (1) which were based on the results of practical experiments.

Summarising, the writer points out that the study of agricultural economics is a method of investigation which only yields approximate results as it is not always possible to isolate the required factors. The method, however, is the most logical one for obtaining a knowledge of the empirical facts governing the management of farms provided the data are collected with care and submitted to searching criticism.

— *Farm Cost Accounting in the United States* in *The Breeder's Gazette*, Vol. LXX, No 13, p. 553, Chicago, September 27, 1916.

A wave of interest in farm cost accounting has been started by county cultural agents in the United States. Some farm accounting has been done by the Minnesota and Illinois universities, from actual detailed annual records, showing the possibilities of a system of finding the cost of

(1) C. GINI. La regolarità dei fenomeni rari, *Giornale degli Economisti*, March 1908, 110-291.

horse labor, of growing a bushel of corn, and raising a pound of beef etc. 7 farm management surveys made in the last few years by cooperation of Government and various state universities, have stirred up a demand practical, simple systems of farm bookkeeping.

During the fall of the year, when the bulk of farm cash comes in, the results of the year's work become apparent, a farm's accounts begin pointing the way to a revision of methods. Some crops have required more than was estimated; machinery repairs count up to an unexpected total; plowing with a tractor costs more than the 50 cents per acre estimated when tractor was bought; every revision of farm methods introduces uncertainty as to farm incomes; the necessity for exact information becomes very more acute.

It is admittedly becoming difficult to figure a generous interest on the values. This of itself is driving ambitious farmers to keep accounts, so to eliminate wasteful methods. The young farmer, who is trying to pay land from its products, is driven to some such expedient. The evolution of efficient farm cost accounting systems will be therefore a great achievement, and progressive farmers who will take advantage of them, will be further above the average of their fellows.

1318 - **Fixing the Price of Milk.** -- ВОСНИЩЕНО N., in *Il Coltivatore*, No. 28, pp. 296 Casale Monferrato, October 10, 1916.

In Italy it is generally considered that the milk produced by a cow should pay for the food consumed, the manure more than pay for the litter and the calf be left over as profit. The cost of the milk therefore varies directly with the cost of the food and inversely with the amount of milk produced.

where p = cost of milk per annum

V = " " food " "

l = amount of milk produced per annum

25 per cent should be added to p for profit and risk of owner, and large towns another 4d a gallon should be added for extra expenses connected with the production and distribution of the milk.

The cost of milk diminishes with the size of the cow as the food consumed is usually 12 times the cow's weight of hay or hay equivalents provided she produces as much milk as a larger animal, the smaller the more economical. Where the cows are used for draught purposes production of milk is smaller, but the cost of the food is then lowered in value of the work done, according to the formula $p = V \cdot L/l$ where L = value of the work done. L is usually greater than the value of the difficulty in the production of milk, and it is for this reason that milk is cheaper in small rural communities where the supply is drawn from the double purpose cow. As a general rule, the price of milk at the farm may be said to be to about twice the cost of the food, and the retail price in towns is about

In Northern Italy the average production of a cow is 700 galls; the average weight of the animals is 8 to 10 cwts., and the average price of milk is 4s to 5s per cwt. so that the price per gallon is

$$\frac{12 \times 9 \times 54}{700} + 25 \% = 8.3 + 25 \% = 10.4d.$$

In Central and Southern Italy the production is only 460 galls. the animals are larger and hay is scarce and dear, so that the cost per gallon is frequently twice as high as in the north.

AGRICULTURAL INDUSTRIES.

3. **Lead Arsenate in Vine Culture** (1). — MUTTELET C. G., in *Annales des Falsifications* Nos. 91 and 95, pp. 298-301. Paris, August and September 1916.

The use of arsenical insecticides, and especially of lead arsenate is on the increase among vine growers, now that their efficiency is realised. Opinions differ as to the best period for applying them; some say it would be better not to treat the vines after the formation of the grapes, while others say that no satisfactory results can be obtained unless the treatment is continued until after the flowering is over and the seeds are formed.

It is entirely from the point of view of public safety that the question has been examined, — to see in what proportion the poisonous salts of lead, arsenic, and copper are found to exist in the produce of vines which have undergone one or other treatment.

The Central Laboratory for the Repression of Fraud has received wines from the Clos des Pins at Cournonterral in Herault, where the vines undergo intense and prolonged treatment with arsenical insecticides. It has been the custom to give them 4 dressings between the bursting of the bud and the end of the flowering, a sixth when the grapes have attained a third of normal size, and a seventh before the maturation of the colour. Besides dressings with lead arsenate, the stocks were powdered with sulphite containing 10 percent of copper sulphate, or with a mixture of sulphur and copper sulphate in the proportion of 9 to 1.

From the end of June 1915, till the vintage there was no rain, traces of sixth arsenical treatment could still be seen on the leaves, and on the blackened by the sulphuring.

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[1] See also R. July 1916, 795.

From the analysis of specimens the following results were obtained:

Specimen	Appearance of specimen.	Results of analysis		
		Lead	Arsenic	Copper
Ordinary wine.	Liquid, red of a rich colour, limpid, no precipitate. . . .	none	Infinitesimal traces	none
Wine lees. . .	Liquid slightly colored, somewhat turbid, containing a great deal of precipitate (1).	none	5 mgms. per 100 litres	faint traces
Coarse lees. . .	Semi-fluid mass, covered with a small quantity of liquid slightly colored (2).	500 mgms. per kilo	10 mgms. per kilo	traces
Sour wine. . .	Liquid, red, faintly colored, limpid, no precipitate	none	Infinitesimal traces	none
Marc.	Mixture of grape stalks, pulp and pips dried in the open air (3). .	200 mgms. per kilo	0.1 mgm. per kilo	traces

(1) The liquid mass carefully decanted before it was analysed, but it still remained turbid.

(2) The whole mass was made homogeneous by shaking before a sample was taken.

(3) The mixture was dry enough for a specimen to be taken immediately.

From the foregoing analyses the following conclusions were drawn:
1) Ordinary and sour wines contain no poisonous salts (salts of lead, arsenic or copper) except for infinitesimal traces of the last two.

2) Wine lees, carefully decanted, but still turbid, contain no lead, but 5 mgms. of arsenic per 100 litres and faint traces of copper. It is therefore harmless.

3) The coarse lees from the grape pressing contain 500 mgms. of lead, 10 mgms. of arsenic and traces of copper per litre. These lees are dangerous.

4) The marc contains per kilo after drying in the open air, 200 mgms. of lead, 0.1 mgm. of arsenic and traces of copper. This marc cannot be used for feeding stock, either impregnated with molasses or in the dry form.

1320 - On the Composition of Cider Brandies. — KAYSER E., in *Bulletin de la Société des Agricul-teurs de France*, pp. 262-265, Paris, October 1916.

The effect was studied on the composition of cider brandy, of the alcoholic ferments No. 153 (*Saccharomyces mali Risleri*) and of an apple ferment No. 158, from the collection at the fermentation Laboratory of the Agronomic Institute.

The apple must was half from Dutch apples, quarter from Locard and

quarter from Petit Trock apples. It contained 103.5 gms. of invert sugar per litre. The must was divided between 6 round flasks, and to Nos. 5 and 6 were added 5 gms. of phosphate of ammonia and 1 gm. of acid phosphate of potassium. Nos. 1, 2, 5 and 6 flasks were sprinkled with the ferment 153, and the flasks 3 and 4 with a mixture of the ferments 153 and 158.

All flasks were allowed to ferment on a vapour bath at a temperature of 26°C. Fermentation set in after 12 hours when 1, 3 and 5 were removed from the bath and put in a cupboard at the temperature of the room, when fermentation was complete, the volume of the liquids was brought to what had been at the start, and they were analysed. The results are given in

TABLE I — *Acidity of apple must (in gms. per litre).*

	1	2	3	4	5	6
l acid	5.28	4.49	5.06	4.49	6.69	6.69
i acid (malic acid)	5.03	4.43	4.84	4.43	13.82	13.80
ile acid (acetic acid)	0.228	0.052	0.200	0.052	0.076	0.086

The amount of acetic acid is decidedly highest in flasks 1 and 3. The changes of temperature were inimical to the ferments, and they therefore rise to more volatile products which Duchlaux considered attributable to the unfavourable conditions.

The distilled liquids were found to contain impurities as shown in

TABLE II. — *Impurities in distilled liquids (per 100 cc alcohol at 100°).*

	1	2	3	4	5	6
	mgms.	mgms.	mgms.	mgms.	mgms.	mgms.
le acid (acetic).	35.10	9.90	22.40	19.80	17.00	26.00
yles	106.80	172.20	120.60	181.80	150.00	150.00
ol	0.32	0.26	0.33	0.40	0.43	0.45
.	72.50	145.40	117.00	208.90	78.00	181.10
r alcohols . . .	160.10	275.00	150.80	208.00	120.00	480.00
alcoholic total .	374.82	602.76	411.13	618.90	359.43	837.55

Speaking generally, it can be said that the composition of these brandies is fully differentiated from that of brandies of industry. The proportion of aldehydes is almost the same as that of the esters, and the proportion of alcohols is greater than that of the esters, whereas the opposite is the case with ordinary cider brandies.

A higher temperature makes a decided increase in the proportion of aldehydes esters and higher alcohols, and diminishes the acid, as is seen by comparing flasks 1 and 2 with the ferment 153.

The addition of phosphate increases all the products, except the aldehydes, at a temperature of 26° C., as is seen with flasks 2 and 6. With flasks 1 and 5 which were subjected to the changes of temperature of the room an increase in ethers, aldehydes and higher alcohols was found.

The effect of the apiculated ferment was seen (in flasks 1 and 3) to diminish, at room temperature, the volatile acids and higher alcohols, and at high temperature on the contrary (in flasks 2 and 4) to increase all the products except the higher alcohols.

1321 - The Action of Different Charcoals on Sugar Solutions, and their Effect on the Analyses of Sugar Products. — PELLET H., in *Bulletin de l'Association des Chimistes de Sucrierie et de Distillerie de France et des Colonies*, Vol. XXXIII. Nos. 10 to 11, pp. 220-227. Paris, April, May and June 1916.

For a long time it has been known that animal charcoal could absorb a certain amount of sugar and that it must therefore be used with discretion. The action of different charcoals has been studied, and their properties are tabulated below.

	Weight per litre when dried	Percentage of water	Percentage of ash
	gms.		
Ordinary animal charcoal or char, powdered.	895	2	81
Char washed with hydrochloric acid.	400	15	55
«Flaming» char.	567	23	50
«Flandrac» char.	280	15	7
«Littoral» char.	350	39	8
«Eponite»	250	12	45
Special charcoal for wines	405	4	traces
A special charcoal (1)	310	6	15
Charcoal from cherry stones (2)	573	15	15

(1) Charcoal of no particular quality tested because it cost about £ 1 per lb.

(2) Charcoal from A. M. PRURI, director of the School of Chemistry and professor at the University of Naples. Tested because it absorbed the most gas.

The decolorizing effect was examined of these different charcoals on a solution of molasses inverted by the Clerget process, and on a liquid clarified by subacetate of lead and subsequently freed from excess of lead by sulphurous acid. The absorbent power of these charcoals was subsequently tried on a pure solution of sugar and on a solution to which acetate and subacetate of lead had been added, as well as on the solutions obtained by treating molasses with subacetate of lead as is done commercially. The following conclusions were drawn :

1) The charcoals which can be used in the analysis of sugars have very different densities. They differ also considerably in composition, some have 81 per cent of ash, whilst others have only traces. They are very different decolorizing power.

2) From a pure solution of sugar, they all absorb more or less sugar. This absorption is less when the sugar solution contains lead.

3) From a solution of molasses clarified by subacetate of lead, the charcoals absorb no sugar, or only traces; some even increase polarisation on the right.

4) When a solution of molasses is analysed by Clerget's inversion process, it is found that certain charcoals cause a diminution in the sugar, whilst others have no appreciable effect. The special charcoal for decolorizing wines gives the best results.

5) This particular charcoal does not absorb the reducing substances contained in beet molasses nor in the non-fermented residue left after distilling sugar-cane molasses, but does appear to absorb non-fermented polarising substances in this residue. This sugar-cane molasses residue contains 7 to 9 per cent of reducing substances, whereas beet molasses has only 0.7 to 2.5 per cent according to the conditions of fermentation, though in special cases it may have more than 2.5 per cent.

322 - **Wheat Offals and their Adulteration.** — SIROT M. and JOSEF G., in *Annales des Falsifications*, Nos. 92-93, pp. 207-217. 4 Tables. Paris, June-July 1916.

Wheat offals have been used from time immemorial for feeding cattle ;

TABLE I.

Name	How obtained and description	How Used
First Flour	First bolting, re-ground semolina, almost pure starch and gluten; the part that contains least cellulose fragments	Kept for human consumption
Second Flour	"Seconds" semolina and regrindings	
Third Flour	Regrindings	
Fourth or brown flour .	Remains of regrindings and sometimes siftings	Offals kept for animal consumption
Washed middlings . . .	Remains from all grindings	
Retard Middlings . . .	From first bolting	
Fine sharps	
Coarse sharps	
Wheat, medium and coarse bran	Husks containing low percentages of starch	
Wheat germ
Wheat dust	Light stuff, hair, starch, powders, dust	
Wheat screenings	Small stones, aborted grains and different seeds	

their nutritive value depends on their composition, and they must therefore be chosen with care.

It was with the object of shewing farmers the composition and value of the different offals and how to recognise fraud that this investigation was made.

After rehearsing the structure of the grain of wheat and the processes it undergoes when ground, the classification of the various products are given in Table I.

All the offal grains were examined, and their composition is shewn in Table II. The numbers given are the mean of many analyses.

Adulterations. — Many commercial waste products of the same appearance as these offal wheats can be mixed with them. Brown flours and pollards are seldom adulterated; occasionally a cheaper flour such as rye, rye, maize or rice is added, but it scarcely affects nutritive value. The same cannot be said of such heavy substances as plaster and earth, which is more frequently found, mill sweepings. With real brans fraud is easier. At the district laboratory of Auxene, two specimens were analysed which one contained about 15 per cent of sawdust and the others 12 per cent of "rice balls". The composition of these and of other products which lend themselves to adulteration are given in the tables.

In addition to the above, stress is laid on the changes which fermentation causes in bran even when pure. This shews itself by an increase in acidity. Ordinary bran has an acidity equivalent to about 0.15 gms. sulphuric acid per cent. When the acidity is more than twice this, the bran should be thrown away.

Conclusion. — Offal wheats may be divided into two chief categories according to their nutritive value: the pollards, coarse and fine, (middlings and sharps) and real brans. These last fetch a price relatively too low, and it would be well if farmers knew to keep them for special cases, if they sought more concentrated forms of food in the cheaper oilcakes in commerce. In any case, they cannot be too strongly urged, when buying bran, to assure themselves that it is unadulterated and in a good state of preservation.

— Investigations on the Peat Beds and the Peat Industry in Canada. — ANREP A., Canada Department of Mines, Mines Branch Bulletin, No. 11, pp. 1-185. Ottawa, 1915.

The present paper is a report on the investigations on peat beds and peat industry carried out in Eastern Canada by the Department of Mines during the years 1913-1914. Thirty-one peat beds are mentioned and 62 species of plants which constitute the peat beds in Eastern Canada. The utilization of peat in the United States, in Switzerland, in Norway, in Denmark and in Russia is discussed, and the plant used is described in an appendix.

INDUSTRIES
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1324 - Sterilized Fresh Eggs. — BLIN H., in *La Nature*, No. 2244, pp. 221-223, Paris, September 30, 1916.

The production of eggs has become an important industry in Europe and America, the principal producing countries being:

	Annual productions Tons
United States	800 000
France	300 000
Germany	250 000 to 270 000
England	125 000
Denmark	55 000

It is due to the development of cold storage that the egg trade has increased so largely in the United States. In 1911, nearly 1000 million eggs were preserved in this way, representing a value of \$6 million, and during the same year Russia exported eggs to the value of £8 600 000. Such a considerable traffic has only become possible owing to the continuous improvements which are introduced in the various processes of preservation and to a strict observance of the following principles:

- 1) Only fresh eggs (not more than a few days old) are preserved and these are all tested before storage.
- 2) The passage of oxygen and of germs through the shell is prevented by avoiding the evaporation of the liquids from within the shell and the consequent production of an air space.
- 3) All stale or abnormal eggs are rejected, and the health and food of the birds are carefully watched.
- 4) No eggs are preserved in very hot or stormy weather.

At the present time various processes are currently employed for the preservation of eggs:

1) *Smearing the shells with grease.* — Paraffin, vaselin, lard, etc. may be used for the purpose, but the method is an expensive one and is only applicable for home use.

2) *Immersion in a liquid.* — Lime water, brine or waterglass may be employed, but the method is not entirely satisfactory as eggs thus preserved sometimes have a musty or lime flavour and the shells crack when put into hot water. Moreover the eggs are not sterilized.

3) *Cold storage.* — Though representing a great advance on previous processes, cold storage does not ensure perfect preservation as the low temperature does not destroy micro-organisms but merely arrest their development, so that if an egg were infected before being put into storage, it is even possible for putrefactive changes to proceed slowly at 10° C. Losses from this cause frequently amount to 5 per cent. After being stored for 4 months, an egg loses its "new laid" flavour and acquires a taste known as "stale" or "cold stored"; after 5 months the egg is no longer suitable for boiling and after 8 or 9 months its quality is approximately that of an egg preserved in lime water. As the effect of a low temperature as a preservative depends so largely on the condition of the

egg when put into store, it is of the first importance that cold storage warehouses be established in the very centres of production so that all transport of fresh eggs be minimised as possible.

4) *Sterilization in closed vessels.* — In order to preserve eggs in a perfectly fresh and wholesome condition, it is necessary to combine cold storage with a preliminary sterilization such as is practised in the Lescardé method which was making great headway in France before the war. By this method the eggs are exposed in closed vessels to an atmosphere consisting of carbon dioxide and nitrogen, and this together with a low temperature is sufficient to destroy bacteria and moulds in a short time and to ensure the subsequent preservation of eggs over a long period. Details of the process are as follows:

On arrival at the factory the eggs are unpacked and tested in order to discard all stale or cracked eggs. The testing is carried out with a simple apparatus consisting of a sheet of cardboard pierced with 168 holes each destined to hold an egg in a vertical position. The cardboard is held in a wooden frame fixed on to an empty wooden case lined with metal sheeting. There are two electric bulbs inside the case and the testing is carried out in a dark room so that it is easy to see the rays passing through the eggs and to distinguish rotten or spotted specimens. For each million eggs handled, 2 of these testers are required.

After being tested the eggs are transferred to a cooling room where they are packed into metal cases. Each case contains 6 trays and holds 1000 eggs. Cavity walls preserve the contents from bumps and an outer covering of wood facilitates the handling of the cases. As each case is filled a little calcium chloride is sprinkled inside to dry the air, and the lid is soldered on to the case, taking care that a small round hole of 5 mm. diam. is left open in the lid. The cases are loaded on to a truck and run into an autoclave very similar in construction to that used for creosoting railway sleepers. There the chamber is first exhausted to get rid of all oxygen — both atmospheric and dissolved in the egg albumen and — then carbon dioxide is then run in through a coil plunged in warm water so that the intense cold of the gas as it issued from the cylinder should not crack the egg shells. When the pressure inside the chamber is equal or slightly above that of the atmosphere, the flow of carbon dioxide is stopped, the saturation of the eggs with carbon dioxide being assured as soon as the manometre becomes steady. As there might be some risk of the carbon dioxide having a solvent effect on the albumen during storage, the pressure of the gas in the autoclave is watched carefully and as soon as it goes above a certain point, carbon dioxide is pumped out and replaced by nitrogen (compressed, sterilized and cooled to 15° C.), the mixture adjusted so that it remains sufficiently antiseptic to ensure sterilization without attacking the albumen. As soon as this has been accomplished and the egg liquids are saturated with nitrogen, the autoclave is opened, the truck drawn out, and the openings in the lids of the cases are quickly sealed. A small solder plug is used for the purpose and it is coated over with a mixture of oil and grease. No danger of infiltration of air during the operation need be feared as the

carbon dioxide absorbed by the eggs is given off for some time after removal from the autoclave.

The cases, after sterilization, are stored at a low temperature (0 to 2° C.), there being no need to make any special provision for ventilation or for drying the air of the store room. On being removed from storage the cases are taken to a room heated to 20° to 25° C., and when the temperature of the eggs has reached 7° to 8° C. (the external temperature of the cases being 15° C.) the cases are opened and the eggs are packed and dispatched to market. A special advantage of the method is evident when the eggs are warmed, for it avoids all condensation of water on the surface (a frequent source of subsequent infection) and for this reason there is no immediate hurry to use the eggs after bringing them out of the store room.

Eggs which have undergone the above process are perfectly sterile evaporation being inhibited, no loss of weight occurs; after 10 months storage the eggs are still suitable for boiling; the air space having remained the same, no difference of any kind can be distinguished between fresh and preserved eggs when tested by light. The method has been in use in France, Italy and the United States either in special factories or in connection with ice factories.

PLANT DISEASES

DISEASES NOT DUE TO PARASITES OR OF UNKNOWN ORIGIN.

15 - **The Effect of Frost on the Roots of Rye.** — ZIMMERMANN H., in *Zeitschrift für Pflankenkrankheiten*, Vol. 26, Nos. 6-7, pp. 321-323, Stuttgart, 1916.

In 1915 the writer observed a change in the roots of rye in fields in the Duchies of Mecklenburg-Schwerin and Mecklenburg-Strelitz which is the cause of the poor yield of grain in these localities. The seed germinated fairly well in the preceding autumn, but the young shoots were able, probably owing to the fact that in the latter part of November they are exposed to alternate spells of warm and cold weather. The crops had also suffered from the attacks of fungi and also in certain districts from slugs.

During the winter there were alternate frosts and thaws which did the plants a good deal of harm especially between the fifth and the tenth of March. In consequence many of the plants, whose adventitious roots became loosened from the soil, withered. Almost all the plants that were not destroyed had had their roots damaged by insects during growth. Good weather would have encouraged the growth of secondary adventitious roots, but as the winter was followed by a dry spring secondary roots were not formed.

The root system that had developed formed a very scanty basis for the plant and the nutrition obtained was insufficient. The rye was therefore abnormal in its development and in many places the harvest showed only half the customary yield. The haulm and the ears were unusually small and the grains badly developed. A lot of the plants were laid so that many of the fields looked as if they had been exposed to hail storms.

Generally, but not invariably, the bad symptoms were more marked in heavy than in light soils, and in some cases at least they seemed to depend upon the previous treatment of the soil. In places where there had been much snow the damage was slight. In some localities wheat and rye-grass had also been affected.

Rolling the fields in spring has given good results even when they have been rolled in the previous autumn. The writer however recommends that they should be rolled for the second time as early as November if the plants show any bad symptoms after the first rolling. Nitrogenous manure has not proved satisfactory, except in the case of calcium nitrate which on some occasions has given fairly good results.

1326 - **The Bad Effects of Frost upon Tea and Quinine Plants in Java.** — BERNARDI in *Mededeelingen van het Proefstation voor Thee*, No. XXXVIII, pp. 1-11, 1 Pl. Buitenzorg, 1915.

During the night of August 30-31, 1915 a temperature of 20° F. was recorded on the plateau of Pengalengan which lies in the middle of western Java at a height of 5000 feet above sea level, on the following night the temperature was again very low being 22° F. The writer describes the results that followed on this drop in temperature in the tea plantation. The young shoots turned brown and, curiously enough, lost their aroma. When the frost occurred again the young branches were killed and all the living tissues of the plants were disorganised. The effects were most disastrous in the plantations that had been weeded recently, the 'China' type and hybrid seemed to be the most resistant.

The writer suggests that the nurseries should be covered at night and that trees such as *Albizia moluccana* and *Acacia decurrens* should be planted to provide shelter for the plantations that are exposed every year to frost. Straw manure, etc. can scarcely be used on large estates.

Cinchona succirubra suffers in the same way from frost, while *C. laurifolia* is more resistant.

DISEASES DUE TO FUNGI, BACTERIA AND OTHER LOWER PLANTS.

GENERALITIES.

1327 - **New or Interesting Fungi Occurring in England.** — GROVE W. B., in *The Journal of Botany British and Foreign*, Vol. LIV No. 643, pp. 185-193; No. 644, pp. 217-218. Pl. 542-543. London, 1916.

This paper contains a continuation of the writer's previous interesting fungi gathered in various parts of England. At present the complete list comprises 252 species or varieties.

In the present contribution which is the fifth of its kind, 40 species are recorded including the following:

- 1) *Diaporthe stictostoma* Sacc. on apple branches at Bristol.
- 2) *Phoma Lavandulae* Gab. on the stems of lavender at Kew Gardens (1).
- 3) *Fusicoccum* ~~on~~ *Aceris* n. sp. on maple branches in Cheshire.
- 4) *F. gloeosporioides* Sacc. and Roum. on *Corylus Avellana* in Cheshire.
- 5) *F. quercinum* Sacc. on the branches of oak near Malvern.
- 6) *Cytospora stictostoma* n. sp. occurring with *Diaporthe stictostoma* on the branches of apple trees at Bristol.

(1) See R. October 1916, No. 11, 3.

- 7) *Cuthospora Euonymi* n. sp. on the leaves and branches of *Euonymus japonicus* at Wallasey (Cheshire) and at Southampton.
- 8) *Ascochyta Vincæ* n. sp. on the leaves of *Vinca major* at Ledbury.
- 9) *Diplodia Passerini* Allesh. at the stem bases in *Antirrhinum* at Birmingham.
- 10) *Septoria oxyspora* Penz. and Sacc. var. *culmorum* n. var. on the stalks of *Dactylis glomerata* at Burcot near Bromsgrove (Worcestershire); it occurs with *Leptosphaeria microscopica* and a *Physalospora* (?).
- 11) *Camatosporium rubicolum* Sacc. on the stems of *Rubus* at Shustoke and on the young branches of *R. discolor* in Herefordshire.
- 11) *Colletotrichum Lineola* Corda on *Dactylis* at Olton.
- 13) *Leptothyrium platanoidis* Pass. on the leaves and on young plants of *Acer Pseudoplatanus* at Park-Mill, Gower-Peninsula and at Himley-Park, Staffordshire; this fungus is a serious pest on young plants.
- 14) *Ramularia sambucina* Sacc. on the leaf segments of *Sambucus nigra* at Studley Castle.
- 15) *Hormiscium calisporum* Grove on the stems of *Conium maculatum* at Hereford.

1328 - On Specialisation in Parasitic Fungi with Special Reference to the Specialisation of Rust on Cereals. — MONTEMARTINI L., in *Rivista di Patologia vegetale*, Year VIII, No. 2, pp. 33-44; No. 6-7, pp. 145-158. Pavia, 1906

By the "specialisation" of species of fungi which are well characterised morphologically and which are shown to be parasitic on many plants meant their particular adaptation and fixation to different hosts so as to form sub-species (also known as specialised species, biological species, sister species). They are distinguished from one another by physiological characters, such as their ability to attack one or several species, even a group of species among the plant hosts.

What is the value of these specialised forms? Are they really fixed? Are they distinct units capable of passing from one region to another, should they be looked upon as local forms due to the variability or the distribution of the various plant hosts?

From observations which have been collected in various parts of the world doubt has been cast upon their stability and the suggestion has been put forward that they are, rather, local adaptive forms, probably temporary, which owe their origin to the various nutritive conditions which are offered to them by the different plant hosts. The suspicion has also arisen that sometimes the localisation on one or another of the plant hosts may be due to the different conditions and different degrees of development of the hosts themselves and to the degree of their susceptibility, which varies with these differences.

The observations of a number of writers on the rust of cereals shows that when a given cereal develops late or in any unseasonable manner it does not offer any resistance to the invasion of the parasite, which normally appears to be localised and fixed on a different plant host. The fact cannot be ignored that in some cases, because of the impossibility of migrating to another host, a pleophagous parasite can become definitely monophagous. Nevertheless the above mentioned facts lead to the conclusion that the greater number of cases (and perhaps it is so in the case of rust) the species remains pleophagous and only localises and spreads itself in a specialised manner on the host or hosts which every year offer it the most

suitable conditions for propagation and growth. However the species is always capable of passing on to other plant hosts when they are in a condition rendering them liable to attack, so that it is not certain that the danger of infection between two different cereals has disappeared; it can only have diminished, on the one hand by the rotation of crops by which the different species are never at the same time in the stage at which they are most susceptible, on the other by the facility with which the parasite adapts itself to a certain food and changes it with difficulty. In spite of this the danger would always be great for plants developing late or out of season because of the presence of what are known as "transition species" ("specie ponti") which possibly offer the parasite an intermediate food between that supplied by the old plant host and the new. It is thus clear that fungi, even parasitic ones, are very sensitive to the chemical composition of their nutrition.

The writer's researches on *Alternaria Camelliae* (Cooke and Mass.) Montem. show that fungi are very sensitive to the chemical composition of the substances in which they live, and that under the influence of food they easily acquire certain definite adaptive characters.

Judging by the writer's experiments with various species such as *Oidium quercinum* Thum., *O. leucoconium* Desm., *Aecidium Violae* Schm., *Phragmidium subcorticium* (Schr.) Wint., *Puccinia Malvacearum* Mont., *P. coronata* Corda of oats, *P. graminis* Pers. of wheat, rye and *Agrostis*, a like sensitiveness is also seen with regard to the different foods which parasitic fungi can extract from the plants which they attack in the case of pleophagous fungi, or from the different organs or parts of an organ of one plant in the case of monophagous fungi, or even from the different stages of development of the infected organ itself. Among other things this sensitiveness appears in differences in germination, and in the virulence of the spores which are produced under these different conditions.

Rust of cereals, or at any rate *Puccinia Rubigo-vera* D. C. f. *Secalis* Erikss., which the writer studied specially during 1916 in the Botanical Garden at Pavia, can pass on to various of the cereals examined — winter corn, spring corn and oats — and the sensitiveness of the plants as regards this fungus varies with their age, but not uniformly for each species of cereal so that the period of maximum sensibility does not always fall at the same stage of development in each species. All these factors may account for the fact that a given cereal is badly attacked in some years while in others it is perfectly healthy, or vice-versa, according to whether in the rotation of crops this species or that species is passing through its most sensitive period at the time when the spores of the fungus coming from other infected crops are most abundant. The phenomenon may be complicated in two ways: first by the action of the atmospheric conditions on the degree of susceptibility of the plant and also on the virulence of the uredospores, and in the second place by the action of the plant host or of its organs in which the uredospores originate, which may have acquired peculiar properties or adaptations.

In any case there is reason to doubt whether in Italy at least the so-

called specialised forms are really fixed, and the evidence points to their being rather adaptive forms due to the parallel development of the host and the parasite.

1329 - Researches upon *Peronospora parasitica* a Pest on Cruciferous Plants.

- GAUMANN E., in *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, Vol. 45, Nos. 18-25, pp. 575-577. Jena, 1916.

Although to judge from their frequent occurrence the *Peronosporales* are the most widely distributed group of Fungi, our knowledge of the different species is still in a chaotic state. The writer has therefore experimented with *Peronospora parasitica*, which is parasitic on cruciferous plants, and has found that specialisation is carried to a very high degree. For instance the species that grows on *Capsella* cannot be transmitted to other plants, nor can the species that grows on *Brassica*. In some cases the plant host is restricted to a single species in others to two or more species belonging to the same genus; thus the variety of fungus which attacks *Sisymbrium officinale* cannot infect *S. Sophia*, while *P. parasitica* will attack *Brassica oleracea* and *B. Rapa*.

To obtain further information on these points numerous forms were examined from the morphological standpoint, comparisons being made between the oospores, the conidia and the conidiophores. Taking the size of the conidia as the fundamental point, the varieties of *P. parasitica* form a continuous line comparable with those described by MÜLLER (1907) and SCHMIDT (1913) for the teleutospores of *Melampsora*, parasitic on *Euphorbia*, and the conidia of *Erysiphe Polygami* respectively. There are even some cases in which differences occur when the host plants are of the same family, for example, in *Arabis*, *Cardamine*, *Nasturtium* and *Sisymbrium* the differentiation of the conidiophores is even greater.

These experiments prove that the specialisation of *P. parasitica* on hosts of the same family is, if possible, greater than it is in many of the *Uredinales*.

1330 - Patents Concerning Preventive Measures against Plant Diseases and Pests. -

See No. 1310 of this Review.

1331 - On the Appearance of Cryptogamic Diseases in Soils Cultivated with Potatoes for the First Time and Sown with Healthy Tubers. - PRATT O. A., in *Journal of Agricultural Research*, Vol. VI, No. 15, pp. 573-575. Washington, D. C., 1916.

It has generally been assumed by plant pathologists that if disease free potatoes are planted on new land the resulting product will be free from disease.

The irrigation works which have been carried out in southern Idaho have brought large tracts of virgin soil under cultivation, but contrary to all expectation the potato crop even in these regions is anything but free from disease. Wilt (*Fusarium oxysporum* Schleret.) blackrot (*F. radicicola* Wollenw.), jelly-end rot (*Fusarium* sp.), russet scab (*Rhizoctonia*), powdery dryrot (*F. trichothecoides* Wollenw.) and common scab (*Actinomyces chromogenus* Gasperini) are all of common occurrence.

MEANS
OF PREVENTION
AND CONTROL
OF VARIOUS
DISEASES
OF VARIOUS
CROPS

The writer has obtained interesting results by planting potatoes in absolutely virgin soil and on land which had been planted before with barley and lucerne; all these experiments were carried out in Idaho. The results of these experiments are summarised in the adjoining Table

	Percentage of plants infected	
	on virgin soil	on soil previously planted with barley and lucerne
<i>Actinomyces chromogenus</i>	9.3	4.7
<i>Rhizoctonia</i>	11.6	less than 2.8
<i>Fusarium</i> spp.	5.6	" " .5
vascular infection	29.3	26.0

The following conclusions are drawn from the results obtained from these experiments:

1) Planting clean seed potatoes on new land does not guarantee a disease-free product.

2) A smaller percentage of disease may appear in the product when clean tubers are planted on land which has been sown with barley and lucerne than when similar tubers are planted on virgin soil.

1332 - **Storage-Rots of Economic Aroids.** — HARTER L. L., in *Journal of Agricultural Research*, Vol. VI, No. 15, pp. 549-571, Fig. 1, Pl. LXXXI-I, XXXIII. Washington, D. C. 1916.

Colocasia esculenta, *C. indica*, *Alocasia* sp. and *Xanthosoma sagittifolium* among aroids are largely cultivated in tropical and sub-tropical regions for the sake of their tubers and aerial organs which are used for food, they have now been introduced into the United States where they are becoming of great economic importance. The diseases that attack these plants are therefore of considerable interest. The corms and tubers are stored in piles in the fields, being protected from frost by coverings of straw and earth; if these piles are not properly ventilated their contents are attacked by various forms of rot to such an extent that they are often rendered unfit for food. Four kinds of rot can be distinguished: 1) Java black-rot which is caused by different species of *Diplodia*; 2) powdery gray-rot, caused by *Fusarium Solani*; 3) Sclerotium-rot, caused by *Sclerotium Rolfsii*; 4) soft-rot, caused by *Bacillus carotovorus*.

Java black-rot — When the tissues are first invaded by the fungus there is very little change in colour but the substances of the tuber or corm becomes soft and pasty, a little later on the diseased parts turn faintly pink and become much firmer owing to the loss of moisture. The rot progresses slowly. The first symptoms appear about 7 days after inoculation, but any time, from 4 to 8 weeks, may elapse before the tissues are

completely blackened. The middle lamella is dissolved and later the hyphae of the parasite penetrate the cell walls and bury themselves among the starch grains. Eventually the whole cellular structure is converted into a disorganised, powdery mass. Cultures of the following forms were used for the inoculation experiments which always gave positive results: 1) *Diplodia tubericola* isolated from infected plants belonging to the genus *Colocasia*; 2) *D. tubericola* from *Ipomoea Batatas*; 3) *D. Maclurae* from a branch of *Toxylon pomiferum*; 4) *D. gossypina* from cotton plants; 5) *Diplodia* sp. from a specimen of *Mangifera indica* from Cuba. All the species of *Diplodia* give rise to the same type of rot. The results of the inoculation experiments are given below.

	<i>Colocasia esculenta</i>		<i>Xanthosoma sagittifolium</i>		<i>Colocasia indica</i>		<i>Allocasia</i> sp.	
	Inoculation	Infection	Inoculation	Infection	Inoculation	Infection	Inoculation	Infection
<i>tubericola</i> from <i>Colocasia</i>	36	29	5	5	4	4	5	5
<i>tubericola</i> from <i>Ipomoea</i>	14	9	11	9	5	5	5	4
<i>Maclurae</i>	10	4	10	5	—	—	4	0
<i>gossypina</i>	15	10	5	3	—	—	4	4
<i>Diplodia</i> sp. from <i>M. indica</i>	10	9	—	—	—	—	—	—

Powdery gray-rot. — Infection usually begins in the wounds made by breaking the corms and tubers apart, showing that it is probably strictly a wound parasite, the diseased part becomes orange in colour and eventually turns brown. The superficial tissues are attacked first and the softening extends to a depth of about $\frac{1}{4}$ or $\frac{1}{2}$ an inch. On drying, the specimen cracks and takes on a dark grey colour.

Fusarium Solani is the specific cause of this disease. For the inoculation experiments cultures of *Fusarium* have been used that were obtained from diseased plants of *Colocasia* and *Ipomoea Batatas*.

Sclerotium-rot. — The surface of a diseased tuber is covered with numerous sclerotia. The infected parts keep their shape but tend to become stringy, and finally numbers of saprophytic fungi and bacteria invade the superficial parts and they liquify and become putrid. *Sclerotium olisii* is the cause of the disease as is proved by the positive results of inoculation experiments. It attacks *Lycopersicon esculentum*, *Arachis hypogaea*, *Brassica oleracea*, *Gossypium* sp., and *Viola* spp. indifferently.

Soft-rot. — Soft-rot develops in the fields as well as in the storage places. The tissues soften and acquire a very unpleasant smell although

there is no discoloration. The middle lamella is dissolved and numerous bacteria develop in the intercellular spaces. Inoculation experiments show that *Bacillus carotovorus* is the cause of the disease.

Moisture and temperature play considerable parts in all these diseases. *Fusarium Solani* is mostly dependent upon the presence of moisture; its spores will not develop unless they lie in a thin film of water there; when artificial inoculations are made the tubers have to be moistened to start the development of the fungus. *Sclerotium Rolfsii* also requires a certain amount of moisture which is best supplied by spraying a few times with an atomizer. The various species of *Diplodia* flourish in a dry environment.

High temperatures encourage rot to such an extent that it is advisable to keep the tubers and corms in a well ventilated place at 8° to 10°. *Bacillus carotovorus* alone is able to produce rot at a temperature less than 9° C.

1333 - Diseases of Some Forage Plants in Natal, Union of South Africa. — VAN BUREN P. A., in *The Agricultural Journal and Small Holder of South Africa*, Vol. IV, No. pp. 37-39, Figs. 1-6. Johannesburg, 1916.

The writer records the presence of *Helminthosporium turcicum* Pat. on Soudan grass (*Sorghum vulgare* var.). This fungus has only been observed on Soudan grass in two localities in Natal and not at all in the other provinces; it has been recorded on maize however in Portuguese East Africa, in Rhodesia and in Natal. Maize and *Sorghum* are also known to be the hosts of this parasite in America and in Europe. Probably the fungus has migrated on to Soudan grass from some other plant either wild or cultivated.

Rhodes grass (*Chloris Gayana*) in Natal is attacked by *Tolyposporium Chloridis* P. Henn. and by *Epichloe* sp., *T. Chloridis* is unknown and *Epichloe* spp. is not recorded on Rhodes grass in the other provinces of the Union.

Helminthosporium crustaceum P. Henn. is already known to occur on forage plants in the Transvaal, in Cape Colony and in Zululand; it is now recorded from Natal on wire grass (*Sporobolus indicus*).

Paspalum, especially *P. dilatatum*, is very seriously attacked. *Claviceps Paspali* S. and H. *P. virgatum* has hitherto been considered immune, but recently it has been discovered that *C. Paspali* attacks this species too. *C. Paspali* is as wide spread in Natal as it is in the Transvaal and very rigorous inspection of seeds is recommended to prevent its introduction into healthy regions.

The spores of Ustilagineae in general adhere closely to the seed and are very resistant, so that it is not advisable to feed infected fodder to cattle. In South Africa formalin (0.5 per cent) is found to be very useful for disinfecting the seeds, although sulphate of copper is also used (1 lb. in 10 gallons water).

In cases where the fungi produce their spores only on the fruits of the host plant and where the grain is not to be gathered in it is suggested that

plants should be mown down as soon as the slightest trace of the disease is seen.

- *Sorosporium Simii* n. sp., a Parasite on *Sorghum halepense* in fatal. — POLE, EVANS I. B., in *The South African Journal of Science*, Vol. XII, No. II, pp. 542-543, Pl. 19. Cape Town, 1916.

Towards the end of February 1915 the writer received a parasite examination which belonged to the order *Ustilaginales*; it had attacked inflorescence of Johnson grass (*Sorghum halepense*). The specimen sent by J. M. SIMS of Maritzburg and it was found to be a new species *Sorosporium* which the writer described under the name of *S. Simii*. It is probable that this fungus can also attack Soudan grass (*Andropogon hum. var. sudanensis*) which is very like *Sorghum halepense* except the fact that it is an annual. The fact that *S. halepense* is a perennial suggests that the infection is not limited to the young plant springing from the seed but that the fungus is able to infect the fully developed plant as is the case in many of the other *Gramineae*.

- Diseases and Pests that Attack Pepper at Banka, Dutch Indies. — See No. 186 of this Review.

- Researches on Blight in Seedlings with Special Reference to those of *Brassica*. — KROPOULOS P., in *Centralblatt für Bakteriologie, Parasitenkunde und Infektionskrankheiten*, Vol. 45, Nos. 6-12, pp. 244-256. Jena, 1916.

The writer gives a short account of the previous work that has been done on the subject of blight in seedlings and then goes on to describe his experiments which were carried out at the Institute of Agricultural Botany at Göttingen. Different parasites can give rise to the disease; according to HESSE and the writer, *Pythium De Baryanum* is found as a parasite on spinach, *Camelina*, *Lepidium*, *Linaria*, *Matthiola* but only rarely on cabbages. *Arotrogus hydnosporus* with hirsute oöspores only appears as a secondary saprophyte. According to DE BARY *Sclerotinia sclerotiorum* is found on the young plants of *Brassica*, *Phaseolus*, *Petunia* and *Zinnia*; he records *Botrytis cinerea* from young plants of *Torenia* and *Brassica*. STÖRMER and EICHINGER state that *Phoma Betae* lives on beetroots, and MONIN has discovered *Olpidium Brassicae* on the seedlings of *Brassica*. STÖRMER, EICHINGER and the writer all record *Moniliopsis Aderici* from young plants of beetroots, *Brassica* and *Raphanus Radicula*. The present experiments show that the seedlings are attacked: 1) before the first leaves have developed, in which case the young plants usually die; 2) when several leaves are developed, in which case the hypocotyl is destroyed down to the fibrovascular vessels and the plant may recover.

The fungus which has been found has a strongly developed mycelium with numerous transverse septa. At first the protoplasm is granular and homogeneous, but later on numerous vacuoles are formed. In a damp sphere an aerial mycelium is produced which branches out almost at right angles. Two types of reproductive organs are found: 1) small cells

of the *Monilia* type, wider than the mycelium and richer in plasma; so far no one has succeeded in isolating these cells and raising the fungus from them; 2) pseudosclerotia with a dark nucleus and a clear envelope, which are produced by the *Monilia* type of cells just described and which may be as large as a pin's head. They produce no apothecia and undergo no resting stage before giving rise to a new mycelium. The fungus found in *Brassica* is identical with *Moniliopsis Aderholdii* Ruhland which is known as « Vermehrungsschimmel » and is very greatly feared.

The most successful remedies are: to sow the seeds sparsely and to sterilise the soil with steam, or by watering it with boiling water, or by the addition of toluol.

1337 - **Citrus Canker (*Pseudomonas Citri*) in the Philippine Islands.** — (1). WESTER P. J., in *The Philippine Agricultural Review*, Vol. IX, No. 2, pp. 155-157. Manila, 1916.

Citrus canker (*Pseudomonas Citri*) originally comes from the East, where it is wide spread in China, Japan, India, Ceylon and in the Malay States. It seems to have been introduced into America from Japan on *Citrus trifoliata* and it occurs in Florida, Alabama, Mississippi, Louisiana and Texas.

The writer discovered it for the first time in the Philippine Island at the Experimental Station at Lamao in 1912, but no great harm was done until the end of the rainy season of 1914. The disease has been recorded also at Bulusan and at Barcelona (Sorsogon), in the province of Tayaba and at Laguna and Batangas; it occurs on the following species of *Citrus*: *C. macrophylla* (alemow); *C. micrantha* (biasong); *C. Webberii* var. *montana* (cabugao); *C. Hystrix* (cabuyao); *C. mitis* (calamondin); *C. Webberii* (calpi); *C. Hystrix* var. *boholensis* (canci); *C. Hystrix* var. *torosa* (colobot); *C. pseudolimonum* (colo-colo); lemon (*C. Limonum*); *C. Southwickii* (limao); *C. limetta* and its variety *aromatica*; *C. excelsa* and its variety *davaoensis* (limon real); mandarine (*C. nobilis*); orange (*C. Aurantium*); pomelo (*C. decumana*); *C. micrantha* var. *microcarpa* (samuyao); *C. vulgaris* (sour orange); *Aegle glutinosa* (taboc); *C. longispina* (talamisan); *C. nobilis* var. *papillaris* (tizon) and *C. trifoliata*.

The least susceptible species, which proved in fact to be almost immune, were *C. nobilis*, *C. nobilis* var. *papillaris*, *C. mitis*, *C. Webberii* var. *montana*, on the other hand *C. pseudolimonum*, *C. Limetta* var. *aromatica*, *C. longispina*, *C. excelsa* var. *davaoensis* and *C. Webberii* are all very susceptible to the infection especially in the first stages of growth, that is when the plants are still in the nurseries. *C. Aurantium* and *C. decumana* are very variable in their resistance to this disease.

The following preventive methods have been successfully used: 1) applications of formaldehyde once in every ten days; in the proportion of 1 part of formaldehyde to 20 parts of water; 2) extensive pruning to suppress all the leaves and branches that show any trace of the disease.

(1) See also *R.* July 1915, No. 763.

38 - Diseases that Attack Vines in Ontario, Canada. — See No. 1350 of this Review.

WEEDS AND PARASITIC FLOWERING PLANTS.

39 - *Xanthium canadense*, a New Weed in Southern Australia. — *The Journal of the Department of Agriculture of South Australia*, Vol. XIX, No. 10, pp. 898-900, 1 Fig. Adelaide 1916.

Xanthium canadense Mill. which is a weed of American origin has appeared at Renmark near the Murray whence it threatens to spread into the adjoining regions. The proper authorities have however taken energetic measures to destroy this plant before its seeds can ripen, a precaution which is very necessary as during the floods the seeds would readily be disseminated into all the low lying regions bordering on the Murray.

40 - *Echium vulgare* and *Phytolacca octandra* Harmful Weeds in New Zealand. (1) — ATKINSON E., in *New Zealand Department of Agriculture, Industries and Commerce, The Journal of Agriculture*, Vol. XII, No. 5, pp. 381-385, 2 Figs. Wellington, 1916.

A description of viper's bugloss (*Echium vulgare* L.) which is very widely spread in New Zealand and more especially in the province of Marlborough where it invades pastures whose soil is dry and light. Cattle refuse to touch this weed. An account of inkweed (*Phytolacca octandra* L.) is also given. This weed predominates in the north and is one of the most important in the province of Auckland. Its dispersal is undoubtedly effected by birds which eat the fruits and drop the undamaged seeds with their excreta.

INJURIOUS INSECTS AND OTHER LOWER ANIMALS.

41 - Locusts in Java. — ROEPKE W., in *Trysmannia*, Year 26, Nos. 1-2, 6-7 and 12, pp. 115-124 337-358 and 758-790, 2 Figs., 7 pl. Batavia, 1915.

GENERALITIES.

The writer gives a brief account of the occurrence of locusts in various countries, and refers to his observations on the recent appearance of these insects in the island of Java.

Almost all the locusts found in Java belong to a species which is also found in the British Indies, *Cyrtacanthacris nigricornis* (*Acridium melanocorne*). They infested the coffee plantations in the middle of Java about 20 years ago, and appeared again in 1897 in this and in other regions, and finally at the beginning of 1915 they invaded the island again their chief objective being the teak forests (*Tectona grandis*) in the middle of the island; several places in the east were also attacked but to a less extent.

The pest reaches its maximum towards the end of the rainy season and disappears at the end of the hot weather (which lasts nearly 6 months). Climatic conditions have a good deal to do with the appearance of the locusts and the writer believes that they are most likely to occur in years when the rainfall is below the average. He has found several kinds of locusts

(1) See also R. March 1916, No. 463; R. July 1916, No. 821; R. August 1916, No. 944. (Ed.)

ut of these *C. nigricornis* is the only one that is harmful. Unlike the European and African locusts this species does not travel over very great distances.

The foliage at the tops of the trees is first attacked, and then the insect spread to the other leaves. They show a decided preference for maize, cocotrees, *Castilloa* and *Artocarpus incisa*, but failing these, other plants are attacked; rice and other cereals, with the exception of maize, are not however damaged.

The writer has discovered a fungus which kills these locusts wholesale; has been identified as *Metarrhizium Anisopliae* and it is prevalent during the rains and attacks the adult insects principally. Among other natural enemies are *Mylabris postulata* and *Scelio javanica* which destroy large numbers of eggs.

Finally the preventive measures in use in Europe and Africa are described, but the writer believes that in Java the locusts will be exterminated more effectually by their natural enemies than by artificial means.

MEANS
OF PREVENTION
AND CONTROL

1342 - Studies Concerning the Application of Hydrocyanic Acid as an Insecticide.

(1) — STONE G. F., in *Journal of the New York Botanical Garden*, Vol. XVII, No. 199, pp. 97-103. New York, 1916.

Hydrocyanic acid, which is so extensively used for fumigating insect pests, possesses the disadvantage of burning the leaves and flowers of the plants on which it is employed. In this paper the writer shows that the sensitiveness of the plant towards the action of the gas varies however, even at the same stage of development, according to the conditions of light and moisture which have acted upon the different organs during their growth.

Five patches of pumpkins were used for the work on light intensity, the first four being covered with canvas shades so that the intensity of the light falling upon them could easily be regulated. In the fifth the plants were exposed to the ordinary light of the greenhouse which was reckoned as having an intensity of 100. The development and the form of the vegetative parts in the several groups varied considerably as is shown in Table I.

TABLE I. *The effect of light intensity upon growth (measurements given in cms).*

	Series				
	1	2	3	4	5
Relative light intensity	24.00	26.00	48.00	74.00	100.00
Average height of plants	22.30	23.30	17.30	19.90	15.50
Average diameter of petiole	0.44	0.53	0.53	0.66	0.71
Average length of internodes	17.30	7.00	5.90	4.30	4.00
Average length and breadth of leaves	70.90	90.30	62.60	80.20	85.50

(1) See also B. June 1911, Nos. 1966-1967; B. July 1911, No. 2340; B. June 1913, No. 765; B. February 1914, No. 191; B. June 1914, No. 587. (Ed.)

The sensitiveness of the plants to the action of the acid varies inversely with the light intensity. The leaves in the first series, which developed under unfavourable lighting conditions, were badly burnt, sometimes being killed outright, while those of the fifth series, under normal conditions are only slightly damaged.

The effects of the soil humidity were equally clear but in this case increase of humidity was accompanied by an increase in the sensibility of the plant to the action of the acid, in spite of the fact that the vegetative parts are much more developed (See Table II).

TABLE II. — *The effect of soil moisture upon growth*
(measurements given in cms).

	Series					
	1	2	3	4	5	6
soil moisture per cent	10.00	15.00	20.00	50.00	60.00	70.00
average height of plants	6.20	7.50	10.20	13.00	17.50	21.20
average length of internodes	4.20	4.50	5.20	5.50	7.50	8.20
average length of petioles	1.30	1.70	2.20	3.20	4.00	3.20
average diameter of petioles	0.30	0.30	0.40	0.45	0.55	0.50
average length and breadth of leaves	6.25	39.50	67.50	162.50	225.00	285.00

The plants belonging to the sixth series which were the most succulent and vigorous were also injured the most by the acid. The same vegetative organs at exactly the same stages of development can exhibit very different degrees of resistance according as their development has been influenced principally by the light intensity or by the soil humidity, and both these factors are apt to vary even in restricted limits of time and space.

From these considerations several useful suggestions arise as to the time at which fumigation should be practised and the method which should be used. Excessive moisture in the air has the same effect upon the tissues as a high moisture content in the soil, that is, the cells become turgid with very thin walls, so that the acid should not be applied in damp or rainy weather. In such cases it is advisable to wait until 4 or 5 sunny days have increased the resistance of the cells and then to choose a starlight night without a moon when the functional activities of the leaves are at their lowest so that the tissues are less sensitive to the action of the gas.

1943 - Experiments Concerning the Destruction of *Lepidiota albohirta*, a Coleopterian Pest on the Sugar Cane in Queensland. — JARVIS E., in Queensland Bureau of Sugar Experiment Stations, Division of Entomology, Bulletin No. 4, pp. 1-14, 1 Pl. Brisbane. 1916.

In this paper the writer gives an account of the results which he obtained from a series of experiments carried out with a view to finding some cheap and efficacious means of destroying the larvae of the grey-back

beetle (*Lepidiota albohirta* Water.). These larvae do a great deal of damage in sugar cane plantations by boring into the rhizomes; they are characterised 1) by their extreme voracity; 2) by their habit of swallowing a large amount of earth which passes unchanged through the body. These two features at once suggest the possibility of killing the insects by poisoning the soil in which they live. The writer has made numerous attempts of this kind using various substances, but wholly satisfactory results have only been obtained with Paris green mixed with damp soil in the proportion of about $\frac{1}{2}$ lb. to a cubic yard of soil.

Such an operation is too costly for practical use in addition to the fact that it presents serious difficulties of manipulation. Better results can however be obtained by mixing the earth with poisonous vegetable products, such as the leaves of the Mauritius bean or of the cow pea (*Vigna Caljang*). These plants also have the advantage of acting as manure. The leaves are treated with a mixture of sugar and water (1 part of sugar to 3 parts of water) and then they are watered with a solution of Paris green and mixed into the soil. Experiments conducted on these lines give entirely positive results: out of 17 larvae, 10 were dead at the end of the first day, and the mortality reached 100 per cent a fortnight later. The poisoned leaves of the cow pea have the great advantage of remaining poisonous and attracting the larvae even when they have been in the ground for a month and are nearly decomposed.

Field experiments have not yet been tried. The writer suggests that one of the leguminous plants mentioned should be sown along the lines of sugar canes, and that it should be buried in the ground after spraying it with Paris green from an ordinary sprayer.

The results of comparative experiments using Paris green and arsenious anhydride are given below.

Paris green:

Larvae killed by the end of the first week	58	per cent
" " " " " " " " second "	75	per cent
" " " " " " " " third "	91.60	per cent

Arsenious anhydride:

Larvae killed by the end of the first week	16	per cent
" " " " " " " " second "	25	per cent
" " " " " " " " third "	33.30	per cent

The mortality when arsenious anhydride is used is certainly inferior and as the cost is six times as great as that of Paris green the latter is to be preferred.

SECTS, ETC.
INJURIOUS
TO VARIOUS
CROPS

1344 - *Xanthorhoe praelectata*, a Pest on New Zealand Flax (*Phormium tenax*) in New Zealand. — MILLER D., in *New Zealand Department of Agriculture, Industries and Commerce, The Journal of Agriculture*, Vol. XII, No. 6, pp. 446-451. Wellington, 1916. *

The larvae of the New Zealand Flax grub (*Xanthorhoe praelectata*) attack *Phormium tenax* in New Zealand, but no great harm is done except in the region of the Mākerua Swamp. These larvae dislike sunlight, and in consequence spend the day at the base of the plant host in hiding among

the dead leaves and other vegetable refuse only emerging during the night. Although they can live in very varied situations they prefer marshy soils probably because these offer the most favourable conditions for their later development.

The number of these parasites is greatly reduced by the birds that haunt the marshes and further work will doubtless lead to some efficacious method of exterminating the pest.

345 - *Aphis pseudobrassicae* a Pest on *Brassica* and *Raphanus* spp. in America. — DAVIS J. J. and SATTERTHWAIT A. P., in *Purdue University, Agricultural Experimental Station, Bulletin* No. 185, Vol. XVIII, pp. 915-940, Figs. 1-7. Lafayette, Indiana, 1916.

Aphis pseudobrassicae Davis (false cabbage aphid or turnip plant aphid) is very wide spread in North America, having been reported from the following localities: Walnut-creek, California; Fort-Collins, Colorado; Gainesville, Florida; Evansville, Goshen and Lafayette, Indiana; Wellington, Kansas; Forest-Hills, Massachusetts; Greenwood, Mississippi; Geneva, New-York; Salem, Ohio; College Station, Texas; Madison, Wisconsin; Treesbank, Manitoba; and Orono, Maine. This insect is also now at Pretoria in South Africa.

It attacks cruciferous plants exclusively and undoubtedly much of the damage attributed in the past to *A. brassicae* has really been caused by this species. The two species differ widely, as *A. pseudobrassicae* has dorsal reticulate areola and also the winged females possess sense organs which lie in the fourth antennal segment.

The following host plants are enumerated: *Brassica Rapa*, *Raphanus sativus*, *B. oleracea*, *B. oleracea acephala*, *Brassica* sp. (mustard), *Brassica* sp. (wild-mustard), *B. nigra*, *B. Napus*, *R. Raphanistrum*, *Matthiola*, *Capsella Bursa-pastoris*.

Among the natural enemies of this parasite are: *Diaretus rapae* Curt., *Achyneuron micans* Howard, *Aphidoletes* sp. and also a fungus, which probably *Empusa Aphidis*.

The writer suggests the following preventive methods: 1) applications of a dilute extract of tobacco mixed with soap-suds, the insecticide must actually come into contact with the insects which are usually to be found on the under surfaces of the leaves; 2) fumigation with prussic acid which is obtained from sulphuric acid and sodium or potassium cyanide. Great care must be taken in using this substance owing to its highly poisonous properties.

346 - *Cholus cattleyae* n. sp. and *Diorymellus laevimargo* n. sp., Curculionid Pests of Orchids in America. — CHAMPION G. C., in *Entomologist's Monthly Magazine*, Vol. III, Series 3, No. 21 (No. 628), pp. 200-202. London, 1916.

A description of two new species of Curculionids belonging to the genera *Cholus* and *Diorymellus*, which have occurred as pests in a greenhouse in Bergen County (New-Jersey) on orchids from Brasil, Colombia, Central America, etc.

Cholus cattleyae has been observed on *Cattleya gigas* where it attacks

not only the aerial parts but also the underground organs. It its characters this insect approaches *C. forbesi* Pasc. which was bred in London on an orchid from Ecuador, and also *C. nigronotatus* and *C. nigromaculatus* Champ. both of which are found in Nicaragua and Panama. The same species has been recorded from an orchid house at Milwaukee (Wisconsin).

Diorymellus laevimargo lives on the flowers of *Catleya*, it will also attack the flowers of *Dendrobium* and it is recorded from a greenhouse at Ithaca (New-York) as a pest on the hypogean parts of orchids. This species resembles *D. 12-striatus* Champ. from Panama in its characters.

1347 - *Aleurocanthus woglumi*, a Hemipteran Pest on Several Cultivated Plants in the Island of Cuba. — JOHNSTON J. R. and CARDIN P., in *Modern Cuba-Cuba Moderna*, Vol. 4 (8), No. 6, pp. 8-11. Havana, Cuba, 1916 :

Aleurocanthus woglumi is recorded from several species of *Citrus*, coffee, mangoes and other plants in the country surrounding Guantanamo (Cuba). A description of the insect is given.

1348 - *Idiocerus niveosparus* and *I. clypealis*, Rhyncota Parasitic on Mango Trees in the Philippines. — WESTER P. J., in *The Philippine Agricultural Review*, Vol. IX, No. 2, pp. 159-160. Manila, 1916.

Every year a great deal of damage is caused to mango trees by *Idiocerus niveosparus* and by the mango-hopper (*I. clypealis*), and in some seasons the whole crop of fruits is destroyed.

The females lay their eggs on the delicate leaves or in the inflorescence, and pierce the tissues to get at the juice, so that the young flowers and leaves eventually drop off. There are several generations every year, the most important appearing during the flowering season of the tree.

As a means of prevention it is suggested that emulsion of crude oil and of train oil should be applied until the fruits are too fully developed to be injured by the insect's attacks ; the applications however must be renewed every ten days.

1349 - *Lygus spinolae* and *L. pratensis*, Rhyncote Pests on Vines in Austria. — FULMER LEOPOLD, in *Zeitschrift für Pflanzenkrankheiten*, Vol. 26, Nos. 6-7, pp. 323-319. Stuttgart 1916.

In 1914 the writer received larvae and adults of one of the Rhyncota which had done a great deal of damage in the spring in the vineyards in the south of the Tyrol. The specimens were sent by I. R. ORST of the School of Agriculture at San Michele, and were identified by MIESTINGER as *Lygus spinolae* Mg. At the same times similar specimens were received from a vineyard near Ligist (Styria) with the information that the shoots damaged by the insects were retarded in their growth and the flowers often dropped off. At the end of April 1916 the writer received again from the vine growing country round Ligist some damaged vine canes containing several young larvae. A little later on some adults of *Lygus pratensis*, a widely distributed species, were received from the same district. From the detailed report furnished by the sender it appears that the Ligist district has suffered in this way since 1897, but that the parasite had not been marked down as the cause of the mischief until 1912. The young

shoots and flowers in this region are often completely destroyed, not only here and there but on all the plants in quite large areas. It has been proved that the parasite for choice attacks well manured vineyards during the first or second year after the manure has been applied.

At the end of April 1916 the writer examined vine shoots and found among the young leaves which were still unfurled very numerous larvae, yellowish-green in colour, and hardly more than 1 mm. long and extremely active. The leaves which had developed showed numerous brown hollows in the dried up tissues, usually arranged end to end between the chief veins. In the leaves which were most severely injured the whole surface was yellow, the discoloration spreading from the edges towards the middle. The wounds occurred regularly and almost exclusively on the upper surfaces of the hairy young leaves; under a microscope the spots were seen to be hollows in the leaf tissue. The older patches were surrounded by a wrinkled brown region and the hole itself had often pierced the leaf right through; these perforations became larger and larger as the leaves grew.

When older leaves were attacked by the insects they became more or less wrinkled, while the younger leaves were completely withered. If they were not too severely attacked the more advanced leaves occasionally became almost normal in appearance in the course of the summer, but they could always be recognised by the brown lines and scars mentioned above. When the writer examined older shoots in the Ligist district at the end of May they only bore injured leaves at the upper ends while those at the bases were normal.

At the end of April there were generally several larvae hardly 1 mm. long on every shoot. In colour these were a clear greenish-yellow and on the under surface of the body between the legs was a rostrum which could be extended, and which terminated in a sharp point. With this rostrum the insect pierced the delicate tissues of the plant and sucked out the juice. At the beginning of larval life the legs and the antennae of the insect are very long as compared with the compact body; during the course of development there are several moults.

The adult insect varies in colour from a grey-brown to a greenish-grey mottled with dark or reddish brown. The colour and pattern of the winged insects is very variable. The most distinctive characters are: the size of the body which lies between 5 mm. and 6 $\frac{1}{2}$ mm., the black outer edge to the anterior pair of wings, the relatively short antennae and the presence of two or three dark rings which are usually found on the posterior legs.

The habits of this new pest are too imperfectly known to allow of the adoption of preventive measures. Very often the winged spring form of *Lygus pratensis* is found in autumn on herbs and low-growing plants in fields and gardens or by roadsides and in clearings. According to REH this insect often emigrates on to lucerne, beetroot, potatoes, hops, tobacco, cabbages, cucumbers, celery, maize, wheat, fruit trees, strawberries and flowering plants, which are damaged by its sucking out the

sap. This emigration is analogous with that of *Calocoris fulvomaculatus* which lives originally on shrubs and low growing plants and which sometimes injures hops quite severely. Just as the hop has several enemies, in addition to *C. fulvomaculatus*, *C. norvegicus*, *Lygus spinola*, and *Adelphocoris vandalicus* which emigrate on to it, so the vine is attacked by more than one species of field Hemiptera, the minimum number being two, namely: *L. pratensis* and *L. spinolae*.

It is not yet certain that spraying the vines with insecticides will serve to protect them against the larvae of *Lygus* which are very tenacious of life. Dufour's remedy (2 $\frac{1}{4}$ lbs. insecticide 6 $\frac{1}{2}$ lbs. soft soap and 22 gallons of water) or 1-1 $\frac{1}{2}$ parts of tobacco extract mixed with 1 per cent solution of soft soap, seem to be the most satisfactory liquid for destroying the parasites when the larvae are most numerous. The most important precaution to adopt is the destruction of anything which can afford the insects shelter in the winter (burning dead leaves etc.)

1350 - **Plant and Animal Pests on the Vine in Ontario, Canada.** — CAESAR L. HOWITT J. E., in *Ontario Department of Agriculture, Fruit Branch Bulletin* 237, pp. 39-48. Fig. Toronto, Ontario, 1916.

The first of the joint authors of this paper treats of the insects which attack the vine in Ontario, giving brief descriptions of them and suggesting appropriate preventive measures to be adopted against them.

The most important of these insects are: the grape-leaf hopper (*Typhlocyba comes*), the grape-vine flea-beetle (*Halica chalybea*) and the rose chafer or rose-bug (*Macrodactylus subspinosus*). None of these insects is invariably to be found in every vineyard in the province, their attack are local and often separated by long intervals.

Among the less important animal pests are the following: the grape berry moth (*Polychrosis vileana*), the grape root-worm (*Fidia viticola*) and the grape plume moth (*Oxyptilus periscelidactylus*).

The second section of the paper deals with the diseases to which the vines in Ontario are subject.

Almost all the common diseases have been recorded from the vineyards in the province, but happily, it is very rare for any one of them to occasion serious losses over large tracts of land. However there have been serious epidemics of black-rot (*Guignardia Bidwellii*) and frequent local attacks of mildew (*Plasmopara viticola*) and of oidium (*Uncinula necator*). In addition to these three diseases the writer also describes anthracnose (*Gloeosporium ampelophagum*), side arm (*Fusicoccum viticolum*), crown gall (*Pseudomonas tumefaciens*) and a non-parasitic disease known as chlorosis.

INJURIOUS VERTEBRATES.

1351 - **The Plague of Voles and its Sudden Disappearance in the District of Ouman Kiev, Russia, in 1915.** — Росси́ковъ К. В. (Rossikov K. W.) in *Земледельческая Газета* (The Agricultural Gazette), Nos. 31, 32, 33, 35, pp. 860-862, 885-886, 909-911, 957-958. Petrograd, 116.

During the last three years several Russian provinces have suffered very severely from an invasion of field voles; in Russia in Europe the plague has been most violent in the south and southwest and in Poland.

The writer was detailed by the Department of Agriculture to deal with this plague in the south-west, where special attention was directed to the Ouman district (Kiev) which was of theoretical as well as practical interest owing to the exceptional speed with which the country was overrun and to the sudden and complete extermination of the invaders. The first sign of the invasion in this district was noticed at the end of the summer of 1913; the area attacked did not include more than 25 acres of winter crops. In the spring of 1914 more than 2750 acres were invaded and towards the beginning of the autumn the area was increased to 27 500 acres, and it has since increased still further.

Fields sown with spring and winter corn, beetroots, clover and lucerne were all overrun by *Microtus arvalis* Pall.; in the same fields *Apodemus agrarius* Pall. and *Mus musculus hortulanus* Nordm. were also found, and less frequently *Mycromys minutus* Pall. and *Cricetulus arenarius* Pall. In clover and lucerne fields lying in damp places *Microtus arvalis* and *Chionomys ratticeps* Keys and Blos. occurred. In oak woods and mixed woods *Evolomys glareolus* Schr. came first in point of numbers, followed by *Mus sylvaticus* L., in copses and clearings *Microtus arvalis* was the most frequent, *Chionomys ratticeps* however appeared to a small extent.

Concerning the actual number of the invaders the following data are given. At the end of the summer of 1913 there were approximately 1 or 2 burrows present to every 5 square yards; in the spring of 1914 the number had increased to 10 or 20, with 2 or 3 nests. The nests belonged to *Microtus arvalis* only. Later observations show that the area was not uniformly invaded: in the north-east of the district the average number of burrows was 1 to 5, in the south-east 5 to 10, and in the north-west 10 to 20 to every 5 square yards. Dealing only with small-holdings, the least densely populated area included about 67 622 acres, the average number of burrows, that is 5 to 10 per 5 square yards, was found in 62 420 acres, and the maximum in 12 137 acres. The land belonging to large land owners was invaded to the same extent. By the autumn of the same year the numbers were more than doubled, so that on an average there was a nest to every 5 square yards or about 1000 to the acre. Taking it for granted that each nest contains a male, a female and two young ones (the ordinary number of young being however not less than 6) it is clear that there were at least 4 000 voles to an acre.

Considerable damage has been done to crops. On the land sown with winter cereals the yield of grain was reduced by 2 quarters per acre with clover and lucerne over a ton per acre of the crop was lost and in some places there was no clover and lucerne left at all. In short, taking numerous areas of 25 acres, it was calculated that at the end of June there were 100 to 150 burrows to every 5 square yards, and to give some idea of the number of nests it is only necessary to add that they were arranged on several levels one above the other. For miangolds the loss was estimated at 5 to 6 cwts. per acre. In the other districts of the province of Kiev and in neighbouring provinces the invaded area was smaller and the voles were less numerous.

The Zemstvo for the Ouman district in the autumn of 1915 allowed £ 1960 to be devoted towards exterminating the plague. The other Zemstvos adopted a similar plan of action.

The second half of the autumn of 1914 was characterised in the province of Kiev by persistent rain, a little snow and frequent variations in the temperature between -5°C . and 8°C . The winter was exceptionally damp and cold, with little snow but with so much rain that the fields became marshy.

Towards the end of January 1915, a local agricultural organisation made a careful survey of the region which was attacked most severely, with a view to exterminating the voles. In two of the lowest lying districts it was noticed that there was an obvious decrease in the number of these pests in the fields planted with winter crops. Bacterial cultures had been prepared by the Institute of Bacteriology at Kiev to be used in dealing with the voles, but before having recourse to these, the writer, accompanied by the farmers of the district, made a second series of observations on April 26, and he recorded in these two districts that almost all the voles belonging to the species recognised in 1914 had died off, not only in the fields bearing winter crops but in all the other localities that had suffered from the invasion.

In the spring floods to a depth of 8 inches had prevented last year's holes and burrows from being seen. In several places new holes were observed which had been made by animals that had escaped drowning by hiding in the stacks of straw left in the fields. In other places which had been less severely attacked and whose physical characters were rather different, the voles had suffered in the same way; that is, in the low lying fields which were flooded the mortality was very high, and in higher places which had been untouched by the floods there were not more than 5 or 10 burrows per acre, as against 30 to 40 per 5 square yards in the preceding autumn.

Judging from the fact that the species principally observed in the Ouman district do not hibernate and must therefore leave their holes every day even if it is only for a short space of time, and also taking into consideration the very unfavourable meteorological conditions existing during the winter 1914-15, the writer concludes that the sudden extermination of the voles in the south-west of Russia was due to the weather. It

confirmation he gives an account of the results of laboratory experiments dealing with the effect of sudden temperature changes upon the mortality of these animals. The first case cited occurred between September 7 and 8, when after 3 or 4 cold days the temperature sank to -30° C. on the morning of the eighth rising again to 8° at one o'clock and sinking to 2° at seven in the evening. Out of 70 voles which were exposed to these conditions and which had been perfectly healthy at 7 p. m. on September 7, 43 were dead by 7 p. m. on September 8, that is, rather over 60 per cent. The following table shows the mortality for the different species:

<i>Apodemus agrarius</i>	mortality	100 per cent
<i>Eutamias glareolus</i>	"	82 " "
<i>Microtus arvalis</i>	"	56 " "
<i>Mus musculus hortulanus</i>	"	50 " "
<i>Cricetulus arenarius</i>	"	33 " "

The most resistant species are *Chionomys ratliceps* and *Cricetus cricetus* both of which survived the frost.

Other observations were carried out from September 29 to October when the temperature dropped to -3° C., with similar results.

These facts according to the writer show clearly the causes for the sudden death of the voles. Microscopic examination, both anatomical and bacteriological, of a large number of dead specimens revealed a perfectly healthy condition of the internal organs. This finally confirms the conclusion that the invasion of voles in 1914 in Kiev and in other provinces in the south-west of Russia was terminated during the winter by the meteorological conditions only (excessive damp and warmth) and not by the intervention of the disease caused by *Bacillus typhi murium* Löffl.